

## FACTORY-PROGRAMMABLE ANY-FREQUENCY CMOS CLOCK GENERATOR

### Features

- [www.silabs.com/custom-timing](http://www.silabs.com/custom-timing)
- Generates up to 8 non-integer-related frequencies from 2.5 kHz to 200 MHz
- Exact frequency synthesis at each output (0 ppm error)
- Glitchless frequency changes
- Low output period jitter: < 70 ps pp, typ
- Configurable Spread Spectrum selectable at each output
- User-configurable control pins:
  - Output Enable (OEB\_0/1/2)
  - Power Down (PDN)
  - Frequency Select (FS\_0/1)
  - Spread Spectrum Enable (SSEN)
- Supports static phase offset
- Rise/fall time control
- Operates from a low-cost, fixed frequency crystal: 25 or 27 MHz
- Separate voltage supply pins provide level translation:
  - Core VDD: 1.8 V, 2.5 V or 3.3 V
  - Output VDDO: 1.8 V, 2.5 V or 3.3 V
- Excellent PSRR eliminates external power supply filtering
- Very low power consumption (25 mA core, typ)
- Available in 2 packages types:
  - 10-MSOP: 3 outputs
  - 20-QFN (4x4 mm): 8 outputs
- PCIe Gen 1 compatible
- Supports HCSL jitter compatible swing

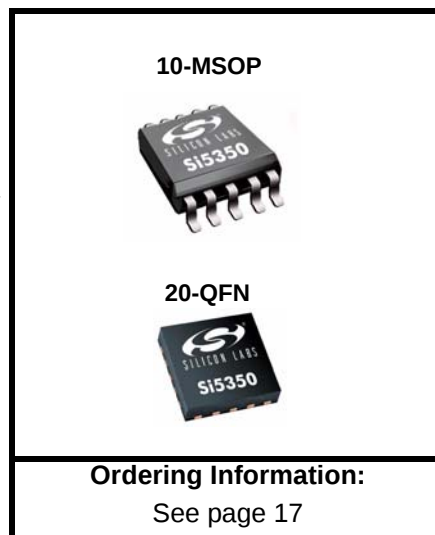
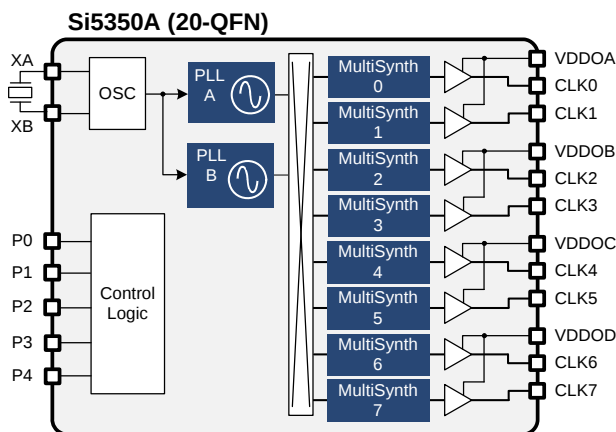
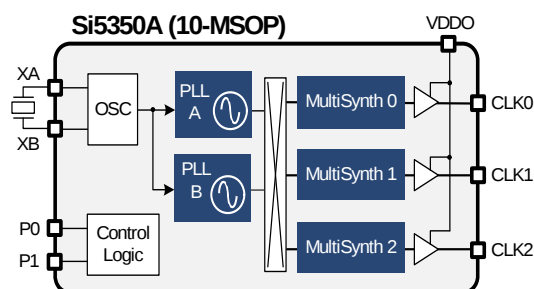
### Applications

- HDTV, DVD/Blu-ray, set-top box
- Audio/video equipment, gaming
- Printers, scanners, projectors
- Handheld instrumentation
- Residential gateways
- Networking/communication
- Servers, storage
- XO replacement

### Description

The Si5350A is a highly-flexible, user-definable custom clock generator that is ideally suited for replacing crystals and crystal oscillators in cost-sensitive applications. Based on a PLL + high resolution fractional divider MultiSynth™ architecture, the Si5350A can generate any frequency up to 200 MHz on each of its outputs with 0 ppm error. Spread spectrum is selectable (on/off) on any of the outputs. Custom pin-controlled Si5350A devices can be requested using the ClockBuilder web-based part number utility ([www.silabs.com/ClockBuilder](http://www.silabs.com/ClockBuilder)).

### Functional Block Diagram



# Si5350A-B

**Table 1. The Complete Si5350/51 Clock Generator Family**

| Part Number                                                                                                                                                                                                                                                                                         | I2C or Pin | Frequency Reference | Programmed?            | Outputs | Datasheet |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------------|------------------------|---------|-----------|
| Si5351A-B-GT                                                                                                                                                                                                                                                                                        | I2C        | XTAL only           | Blank                  | 3       | Si5351-B  |
| Si5351A-B-GM                                                                                                                                                                                                                                                                                        | I2C        | XTAL only           | Blank                  | 8       | Si5351-B  |
| Si5351B-B-GM                                                                                                                                                                                                                                                                                        | I2C        | XTAL and/or Voltage | Blank                  | 8       | Si5351-B  |
| Si5351C-B-GM                                                                                                                                                                                                                                                                                        | I2C        | XTAL and/or CLKIN   | Blank                  | 8       | Si5351-B  |
| Si5351A-Bxxxxx-GT                                                                                                                                                                                                                                                                                   | I2C        | XTAL only           | Factory Pre-Programmed | 3       | Si5351-B  |
| Si5351A-Bxxxxx-GM                                                                                                                                                                                                                                                                                   | I2C        | XTAL only           | Factory Pre-Programmed | 8       | Si5351-B  |
| Si5351B-Bxxxxx-GM                                                                                                                                                                                                                                                                                   | I2C        | XTAL and/or Voltage | Factory Pre-Programmed | 8       | Si5351-B  |
| Si5351C-Bxxxxx-GM                                                                                                                                                                                                                                                                                   | I2C        | XTAL and/or CLKIN   | Factory Pre-Programmed | 8       | Si5351-B  |
| Si5350A-Bxxxxx-GT                                                                                                                                                                                                                                                                                   | Pin        | XTAL only           | Factory Pre-Programmed | 3       | Si5350A-B |
| Si5350A-Bxxxxx-GM                                                                                                                                                                                                                                                                                   | Pin        | XTAL only           | Factory Pre-Programmed | 8       | Si5350A-B |
| Si5350B-Bxxxxx-GT                                                                                                                                                                                                                                                                                   | Pin        | XTAL and/or Voltage | Factory Pre-Programmed | 3       | Si5350B-B |
| Si5350B-Bxxxxx-GM                                                                                                                                                                                                                                                                                   | Pin        | XTAL and/or Voltage | Factory Pre-Programmed | 8       | Si5350B-B |
| Si5350C-Bxxxxx-GT                                                                                                                                                                                                                                                                                   | Pin        | XTAL and/or CLKIN   | Factory Pre-Programmed | 3       | Si5350C-B |
| Si5350C-Bxxxxx-GM                                                                                                                                                                                                                                                                                   | Pin        | XTAL and/or CLKIN   | Factory Pre-Programmed | 8       | Si5350C-B |
| <b>Notes:</b> <ol style="list-style-type: none"><li>1. XTAL = 25/27 MHz, Voltage = 0 to VDD, CLKIN = 10 to 100 MHz. "xxxxx" = unique custom code.</li><li>2. Create custom, factory pre-programmed parts at <a href="http://www.silabs.com/ClockBuilder">www.silabs.com/ClockBuilder</a>.</li></ol> |            |                     |                        |         |           |

# TABLE OF CONTENTS

| <b><u>Section</u></b>                          | <b><u>Page</u></b> |
|------------------------------------------------|--------------------|
| <b>1. Electrical Specifications</b>            | <b>4</b>           |
| <b>2. Typical Application</b>                  | <b>8</b>           |
| 2.1. Si5350A Replaces Multiple Clocks and XOs  | 8                  |
| 2.2. Applying a Reference Clock at XTAL Input  | 8                  |
| 2.3. HCSL Compatible Outputs                   | 9                  |
| <b>3. Functional Description</b>               | <b>10</b>          |
| <b>4. Configuring the Si5350A</b>              | <b>11</b>          |
| 4.1. Crystal Inputs (XA, XB)                   | 11                 |
| 4.2. Output Clocks (CLK0–CLK7)                 | 11                 |
| 4.3. Programmable Control Pins (P0–P4) Options | 12                 |
| 4.4. Design Considerations                     | 14                 |
| <b>5. Pin Descriptions</b>                     | <b>15</b>          |
| 5.1. 20-pin QFN                                | 15                 |
| 5.2. 10-pin MSOP                               | 16                 |
| <b>6. Ordering Information</b>                 | <b>17</b>          |
| <b>7. 20-Pin QFN Package Outline</b>           | <b>18</b>          |
| <b>8. Land Pattern: 20-Pin QFN</b>             | <b>20</b>          |
| <b>9. 10-pin MSOP Package Outline</b>          | <b>22</b>          |
| <b>10. Land Pattern: 10-Pin MSOP</b>           | <b>24</b>          |
| <b>11. Top Marking</b>                         | <b>26</b>          |
| 11.1. 20-Pin QFN Top Marking                   | 26                 |
| 11.2. Top Marking Explanation                  | 26                 |
| 11.3. 10-Pin MSOP Top Marking                  | 27                 |
| 11.4. Top Marking Explanation                  | 27                 |
| <b>Document Change List</b>                    | <b>28</b>          |
| <b>Contact Information</b>                     | <b>29</b>          |

## 1. Electrical Specifications

**Table 2. Recommended Operating Conditions**

| Parameter                                                                                                                                                                                                                                                                                                                                                                                                                | Symbol            | Test Condition | Min  | Typ | Max  | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------|------|-----|------|------|
| Ambient Temperature                                                                                                                                                                                                                                                                                                                                                                                                      | T <sub>A</sub>    |                | −40  | 25  | 85   | °C   |
| Core Supply Voltage                                                                                                                                                                                                                                                                                                                                                                                                      | V <sub>DD</sub>   |                | 1.71 | 1.8 | 1.89 | V    |
|                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                | 2.25 | 2.5 | 2.75 | V    |
|                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                | 3.0  | 3.3 | 3.60 | V    |
| Output Buffer Voltage                                                                                                                                                                                                                                                                                                                                                                                                    | V <sub>DDOx</sub> |                | 1.71 | 1.8 | 1.89 | V    |
|                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                | 2.25 | 2.5 | 2.75 | V    |
|                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                | 3.0  | 3.3 | 3.60 | V    |
| <b>Note:</b> 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. VDD and VDDOx can be operated at independent voltages. Power supply sequencing for VDD and VDDOx requires that all VDDOx be powered up either before or at the same time as VDD. |                   |                |      |     |      |      |

**Table 3. DC Characteristics**

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

| Parameter                                                  | Symbol      | Test Condition                                    | Min | Typ | Max | Unit |
|------------------------------------------------------------|-------------|---------------------------------------------------|-----|-----|-----|------|
| Core Supply Current*                                       | $I_{DD}$    | Enabled 3 outputs                                 | —   | 20  | 30  | mA   |
|                                                            |             | Enabled 8 outputs                                 | —   | 25  | 40  | mA   |
|                                                            |             | Power Down (PDN = VDD)                            | —   | —   | 50  | μA   |
| Output Buffer Supply Current (Per Output)*                 | $I_{DDOx}$  | $C_L = 5\text{ pF}$                               | —   | 2.2 | 5.6 | mA   |
| Input Current                                              | $I_{P1-P4}$ | Pins P1, P2, P3, P4<br>$V_{P1-P4} < 3.6\text{ V}$ | —   | —   | 10  | μA   |
|                                                            | $I_{P0}$    | Pin P0                                            | —   | —   | 30  | μA   |
| Output Impedance                                           | $Z_{OI}$    | 3.3 V VDDO, default high drive.                   | —   | 50  | —   | Ω    |
| <b>*Note:</b> Output clocks less than or equal to 100 MHz. |             |                                                   |     |     |     |      |

**Table 4. AC Characteristics**(V<sub>DD</sub> = 1.8 V ±5%, 2.5 V ±10%, or 3.3 V ±10%, T<sub>A</sub> = –40 to 85 °C)

| Parameter                           | Symbol            | Test Condition                                                                                                    | Min  | Typ  | Max  | Unit |
|-------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Powerup Time                        | T <sub>RDY</sub>  | From V <sub>DD</sub> = V <sub>DDmin</sub> to valid output clock, C <sub>L</sub> = 5 pF, f <sub>CLKn</sub> > 1 MHz | —    | 2    | 10   | ms   |
| Powerup Time, PLL Bypass Mode       | T <sub>BYP</sub>  | From V <sub>DD</sub> = V <sub>DDmin</sub> to valid output clock, C <sub>L</sub> = 5 pF, f <sub>CLKn</sub> > 1 MHz | —    | 0.5  | 1    | ms   |
| Output Enable Time                  | T <sub>OE</sub>   | From OEB assertion to valid clock output, C <sub>L</sub> = 5 pF, f <sub>CLKn</sub> > 1 MHz                        | —    | —    | 10   | μs   |
| Output Frequency Transition Time    | T <sub>FREQ</sub> | f <sub>CLKn</sub> > 1 MHz                                                                                         | —    | —    | 10   | μs   |
| Spread Spectrum Frequency Deviation | SS <sub>DEV</sub> | Down spread.<br>Selectable in 0.1% steps.                                                                         | –0.1 | —    | –2.5 | %    |
| Spread Spectrum Modulation Rate     | SS <sub>MOD</sub> |                                                                                                                   | 30   | 31.5 | 33   | kHz  |

**Table 5. Input Characteristics**(V<sub>DD</sub> = 1.8 V ±5%, 2.5 V ±10%, or 3.3 V ±10%, T<sub>A</sub> = –40 to 85 °C)

| Parameter                | Symbol               | Test Condition                   | Min                   | Typ | Max                   | Unit |
|--------------------------|----------------------|----------------------------------|-----------------------|-----|-----------------------|------|
| Crystal Frequency        | f <sub>XTAL</sub>    |                                  | 25                    | —   | 27                    | MHz  |
| P0-P4 Input Low Voltage  | V <sub>IL_P0-4</sub> |                                  | –0.1                  | —   | 0.3 × V <sub>DD</sub> | V    |
| P0-P4 Input High Voltage | V <sub>IH_P0-4</sub> | V <sub>DD</sub> = 2.5 V or 3.3 V | 0.7 × V <sub>DD</sub> | —   | 3.60                  | V    |
|                          |                      | V <sub>DD</sub> = 1.8 V          | 0.8 × V <sub>DD</sub> | —   | 3.60                  | V    |

**Table 6. Output Characteristics**(V<sub>DD</sub> = 1.8 V ±5%, 2.5 V ±10%, or 3.3 V ±10%, T<sub>A</sub> = –40 to 85 °C)

| Parameter                    | Symbol                         | Test Condition                                             | Min                   | Typ | Max | Unit |
|------------------------------|--------------------------------|------------------------------------------------------------|-----------------------|-----|-----|------|
| Frequency Range <sup>1</sup> | F <sub>CLK</sub>               |                                                            | 0.0025                | —   | 200 | MHz  |
| Load Capacitance             | C <sub>L</sub>                 | F <sub>CLK</sub> < 100 MHz                                 | —                     | —   | 15  | pF   |
| Duty Cycle                   | DC                             | F <sub>CLK</sub> ≤ 160 MHz, Measured at V <sub>DD</sub> /2 | 45                    | 50  | 55  | %    |
|                              |                                | F <sub>CLK</sub> > 160 MHz, Measured at V <sub>DD</sub> /2 | 40                    | 50  | 60  | %    |
| Rise/Fall Time               | t <sub>r</sub> /t <sub>f</sub> | 20%–80%, C <sub>L</sub> = 5 pF                             | —                     | 1   | 1.5 | ns   |
| Output High Voltage          | V <sub>OH</sub>                |                                                            | V <sub>DD</sub> – 0.6 | —   | —   | V    |
| Output Low Voltage           | V <sub>OL</sub>                |                                                            | —                     | —   | 0.6 | V    |

**Notes:**

1. Only two unique frequencies above 112.5 MHz can be simultaneously output.
2. Measured over 10k cycles. Jitter is only specified at the default high drive strength (50 Ω output impedance).
3. Jitter is highly dependent on device frequency configuration. Specifications represent a “worst case, real world” frequency plan; actual performance may be substantially better. Three-output 10MSOP package measured with clock outputs of 74.25, 24.576, and 48 MHz. Eight-output 20QFN package measured with clock outputs of 33.33, 74.25, 27, 24.576, 22.5792, 28.322, 125, and 48 MHz.

**Table 6. Output Characteristics (Continued)**

( $V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 10\%$ , 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     |
|--------------------------------------|-----------|-------------------------------------------|-----|-----|-----|----------|
| Period Jitter <sup>2,3</sup>         | $J_{PER}$ | 20-QFN, 4 outputs running,<br>1 per VDDO  | —   | 40  | 95  | ps pk-pk |
|                                      |           | 10-MSOP or 20-QFN,<br>all outputs running | —   | 70  | 155 |          |
| Cycle-to-Cycle Jitter <sup>2,3</sup> | $J_{CC}$  | 20-QFN, 4 outputs running,<br>1 per VDDO  | —   | 50  | 90  | ps pk    |
|                                      |           | 10-MSOP or 20-QFN,<br>all outputs running | —   | 70  | 150 |          |

**Notes:**

1. Only two unique frequencies above 112.5 MHz can be simultaneously output.
2. Measured over 10k cycles. Jitter is only specified at the default high drive strength (50  $\Omega$  output impedance).
3. Jitter is highly dependent on device frequency configuration. Specifications represent a “worst case, real world” frequency plan; actual performance may be substantially better. Three-output 10MSOP package measured with clock outputs of 74.25, 24.576, and 48 MHz. Eight-output 20QFN package measured with clock outputs of 33.33, 74.25, 27, 24.576, 22.5792, 28.322, 125, and 48 MHz.

**Table 7. 25 MHz Crystal Requirements<sup>1,2</sup>**

| Parameter                    | Symbol     | Min | Typ | Max | Unit          |
|------------------------------|------------|-----|-----|-----|---------------|
| Crystal Frequency            | $f_{XTAL}$ | —   | 25  | —   | MHz           |
| Load Capacitance             | $C_L$      | 6   | —   | 12  | pF            |
| Equivalent Series Resistance | $r_{ESR}$  | —   | —   | 150 | $\Omega$      |
| Crystal Max Drive Level      | $d_L$      | 100 | —   | —   | $\mu\text{W}$ |

**Notes:**

1. Crystals which require load capacitances of 6, 8, or 10 pF should use the device's internal load capacitance for optimum performance. See register 183 bits 7:6. A crystal with a 12 pF load capacitance requirement should use a combination of the internal 10 pF load capacitance in addition to external 2 pF load capacitance (e.g., by using 4pF capacitors on XA and XB).
2. Refer to “AN551: Crystal Selection Guide” for more details.

**Table 8. 27 MHz Crystal Requirements<sup>1,2</sup>**

| Parameter                    | Symbol     | Min | Typ | Max | Unit          |
|------------------------------|------------|-----|-----|-----|---------------|
| Crystal Frequency            | $f_{XTAL}$ | —   | 27  | —   | MHz           |
| Load Capacitance             | $C_L$      | 6   | —   | 12  | pF            |
| Equivalent Series Resistance | $r_{ESR}$  | —   | —   | 150 | $\Omega$      |
| Crystal Max Drive Level Spec | $d_L$      | 100 | —   | —   | $\mu\text{W}$ |

**Notes:**

1. Crystals which require load capacitances of 6, 8, or 10 pF should use the device's internal load capacitance for optimum performance. See register 183 bits 7:6. A crystal with a 12 pF load capacitance requirement should use a combination of the internal 10 pF load capacitance in addition to external 2 pF load capacitance (e.g., by using 4pF capacitors on XA and XB).
2. Refer to “AN551: Crystal Selection Guide” for more details.

**Table 9. Thermal Characteristics**

| Parameter                                 | Symbol        | Test Condition | Package | Value | Unit |
|-------------------------------------------|---------------|----------------|---------|-------|------|
| Thermal Resistance<br>Junction to Ambient | $\theta_{JA}$ | Still Air      | 10-MSOP | 131   | °C/W |
|                                           |               |                | 20-QFN  | 119   | °C/W |
| Thermal Resistance<br>Junction to Case    | $\theta_{JC}$ | Still Air      | 20-QFN  | 16    | °C/W |

**Table 10. Absolute Maximum Ratings**

| Parameter                                                                                                                                                                                                                                                                                                                | Symbol         | Test Condition      | Value                    | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|--------------------------|------|
| DC Supply Voltage                                                                                                                                                                                                                                                                                                        | $V_{DD\_max}$  |                     | –0.5 to 3.8              | V    |
| Input Voltage                                                                                                                                                                                                                                                                                                            | $V_{IN\_P1-4}$ | Pins P1, P2, P3, P4 | –0.5 to 3.8              | V    |
|                                                                                                                                                                                                                                                                                                                          | $V_{IN\_P0}$   | P0                  | –0.5 to ( $V_{DD}+0.3$ ) | V    |
|                                                                                                                                                                                                                                                                                                                          | $V_{IN\_XA/B}$ | Pins XA, XB         | –0.5 to 1.3 V            | V    |
| Junction Temperature                                                                                                                                                                                                                                                                                                     | $T_J$          |                     | –55 to 150               | °C   |
| <b>Note:</b> Permanent device damage may occur if the absolute maximum ratings are exceeded. Functional operation should be restricted to the conditions as specified in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. |                |                     |                          |      |

## 2. Typical Application

### 2.1. Si5350A Replaces Multiple Clocks and XOs

The Si5350A is a user-definable custom clock generator that is ideally suited for replacing crystals and crystal oscillators in cost-sensitive applications. An example application is shown in Figure 1.

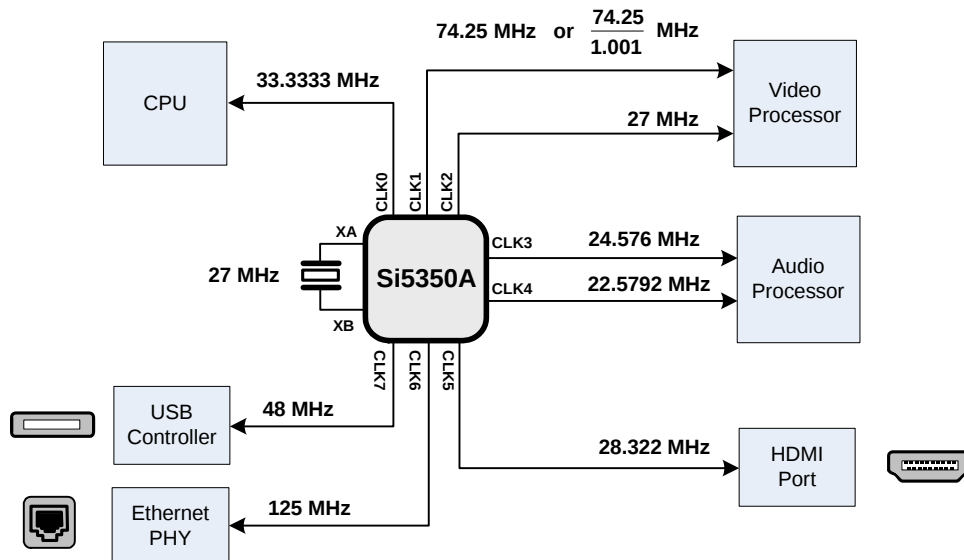


Figure 1. Example of an Si5350A in an Audio/Video Application

### 2.2. Applying a Reference Clock at XTAL Input

The Si5350A can be driven with a clock signal through the XA input pin.

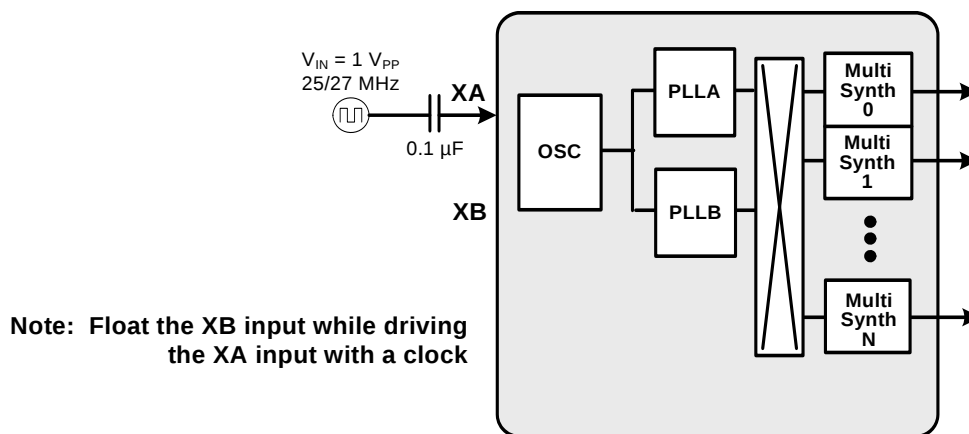


Figure 2. Si5350A Driven by a Clock Signal

### 2.3. HCSL Compatible Outputs

The Si5350A can be configured to support HCSL compatible swing when the VDDO of the output pair of interest is set to 2.5 V (i.e., VDDOA must be 2.5 V when using CLK0/1; VDDOB must be 2.5 V for CLK2/3 and so on).

The circuit in Figure 3 must be applied to each of the two clocks used, and one of the clocks in the pair must also be inverted to generate a differential pair.

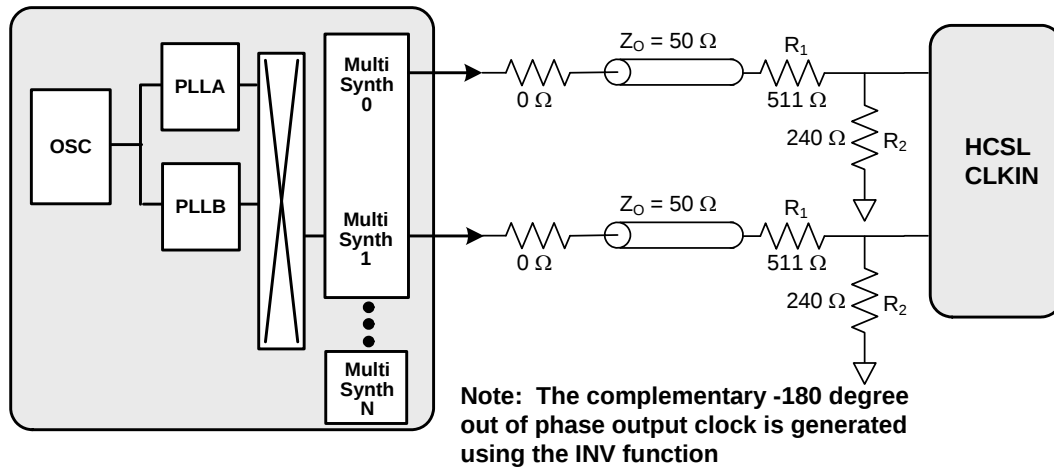


Figure 3. Si5350A Output is HCSL Compatible

## 3. Functional Description

The Si5350A's synthesis architecture consists of two high-frequency PLLs in addition to one high-resolution fractional MultiSynth™ divider per output. A block diagram of both the 3-output and 8-output versions are shown in Figure 4. This unique architecture allows the Si5350A to simultaneously generate up to eight independent, non-integer-related frequencies. In addition, each MultiSynth™ is configurable with two different frequencies (F1\_x, F2\_x). This allows a pin controlled glitchless frequency change at each output (CLK0 to CLK5).

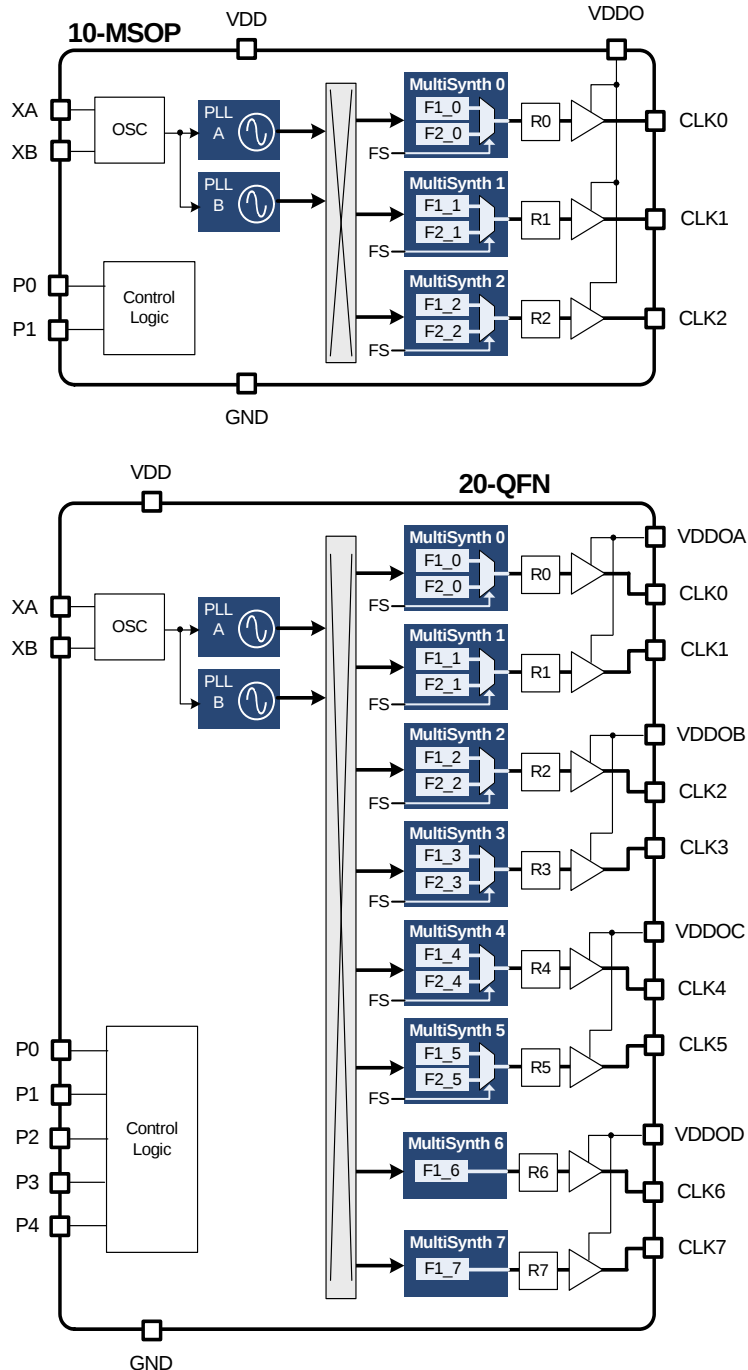


Figure 4. Block Diagrams of 3-Output and 8-Output Si5350A Devices

## 4. Configuring the Si5350A

The Si5350A is a factory-programmed custom clock generator that is user definable with a simple to use web-based utility ([www.silabs.com/ClockBuilder](http://www.silabs.com/ClockBuilder)). The ClockBuilder utility provides a simple graphical interface that allows the user to enter input and output frequencies along with other custom features as described in the following sections. All synthesis calculations are automatically performed by ClockBuilder to ensure an optimum configuration. A unique part number is assigned to each custom configuration.

### 4.1. Crystal Inputs (XA, XB)

The Si5350A uses a fixed-frequency standard AT-cut crystal as a reference to synthesize its output clocks.

#### 4.1.1. Crystal Frequency

The Si5350A can operate using either a 27 MHz or a 25 MHz crystal.

#### 4.1.2. Internal XTAL Load Capacitors

Internal load capacitors are provided to eliminate the need for external components when connecting a XTAL to the Si5350A. The total internal XTAL load capacitance ( $C_L$ ) can be selected to be 0, 6, 8, or 10 pF. XTALs with alternate load capacitance requirements are supported using additional external load capacitance  $\leq 2$  pF (e.g., by using  $\leq 4$  pF capacitors on XA and XB) as shown in Figure 5.

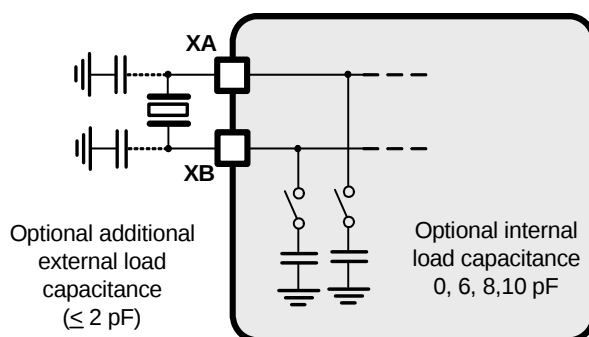


Figure 5. External XTAL with Optional Load Capacitors

## 4.2. Output Clocks (CLK0–CLK7)

The Si5350A is orderable as a 3-output (10-MSOP) or 8-output (20-QFN) clock generator. Output clocks CLK0 to CLK5 can be ordered with two clock frequencies ( $F1_x$ ,  $F2_x$ ) which are selectable with the optional frequency select pins ( $FS0/1$ ). See “4.3.3. Frequency Select ( $FS_0$ ,  $FS_1$ )” for more details on the operation of the frequency select pins.

### 4.2.1. Output Clock Frequency

Outputs can be configured at any frequency from 2.5 kHz up to 200 MHz. However, only two unique frequencies above 112.5 MHz can be simultaneously output. For example, 125 MHz (CLK0), 130 MHz (CLK1), and 150 MHz (CLKx) is not allowed. Note that multiple copies of frequencies above 112.5 MHz can be provided, for example, 125 MHz could be provided on four outputs (CLKS0-3) simultaneously with 130 MHz on four different outputs (CLKS4-7).

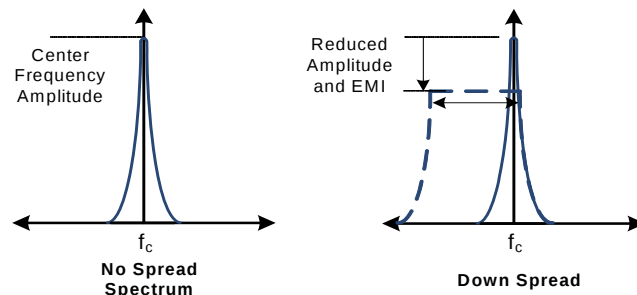
### 4.2.2. Spread Spectrum

Spread spectrum can be enabled on any of the clock outputs that use PLLA as its reference. Spread spectrum is useful for reducing electromagnetic interference (EMI). Enabling spread spectrum on an output clock modulates its frequency, which effectively reduces the overall amplitude of its radiated energy. Note that spread spectrum is not available on clocks synchronized to PLLB.

The Si5350A supports several levels of spread spectrum allowing the designer to choose an ideal compromise between system performance and EMI compliance.

An optional spread spectrum enable pin (SSEN) is configurable to enable or disable the spread spectrum feature.

See “4.3.1. Spread Spectrum Enable (SSEN)” for details.



**Figure 6. Available Spread Spectrum Profiles**

#### 4.2.3. Invert/Non-Invert

By default, each of the output clocks are generated in phase (non-inverted) with respect to each other. An option to invert any of the clock outputs is also available.

#### 4.2.4. Output State When Disabled

There are up to three output enable pins configurable on the Si5350A as described in “4.3.4. Output Enable (OEB\_0, OEB\_1, OEB\_2)”. The output state when disabled for each of the outputs is configurable as output high, output low, or high-impedance.

#### 4.2.5. Powering Down Unused Outputs

Unused clock outputs can be completely powered down to conserve power.

### 4.3. Programmable Control Pins (P0–P4) Options

Up to five programmable control pins (P0-P4) are configurable allowing direct pin control of the following features:

#### 4.3.1. Spread Spectrum Enable (SSEN)

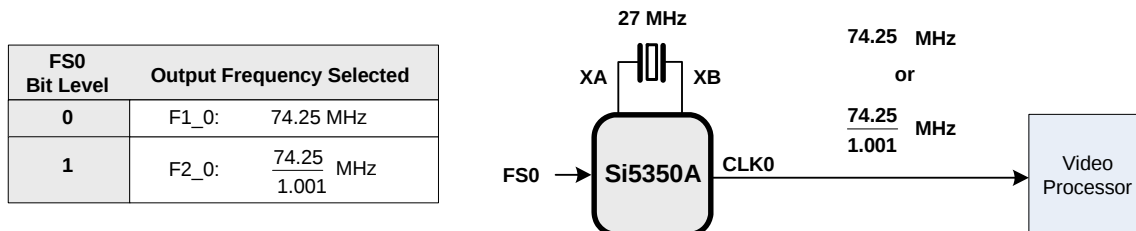
An optional control pin allows disabling the spread spectrum feature for all outputs that were configured with spread spectrum enabled. Hold SSEN low to disable spread spectrum. The SSEN pin provides a convenient method of evaluating the effect of using spread spectrum clocks during EMI compliance testing.

#### 4.3.2. Power Down (PDN)

An optional power down control pin allows a full shutdown of the Si5350A to minimize power consumption when its output clocks are not being used. The Si5350A is in normal operation when the PDN pin is held low and is in power down mode when held high. Power consumption when the device is in power down mode is indicated in Table 3 on page 4.

#### 4.3.3. Frequency Select (FS\_0, FS\_1)

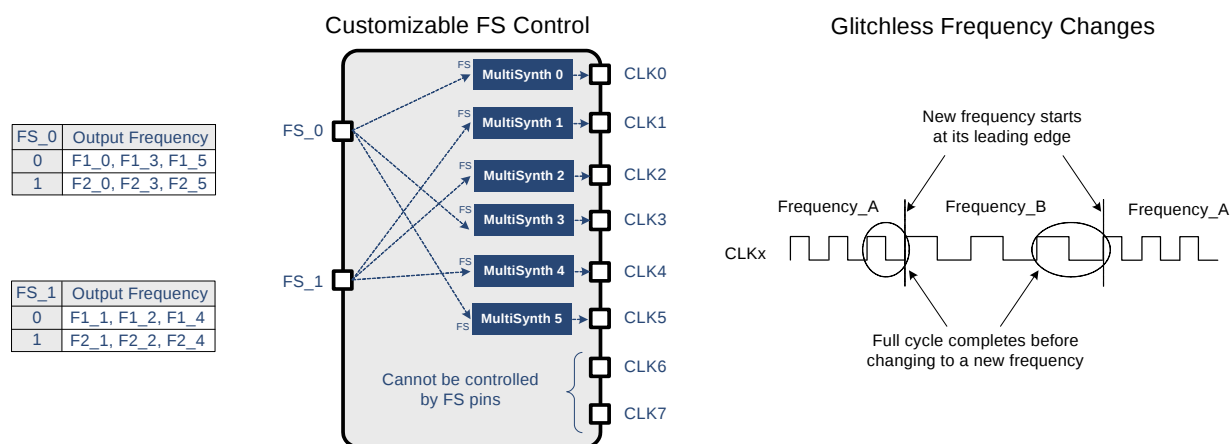
The Si5350A offers the option of configuring up to two frequencies per clock output on CLK0-CLK5. This is a useful feature for applications that need to support more than one clock rate on the same output. An example of this is shown in Figure 7 where the FS pins selects which frequency is generated from the clock output: F1\_0 is generated when FS is set low, and F2\_0 is generated when FS is set high.



**Figure 7. Example of Generating Two Clock Frequencies from the Same Clock Output**

Up to two frequency select pins are available on the Si5350A. Each of the frequency select pins can be linked to any of the clock outputs as shown in Figure 8. For example, FS\_0 can be linked to control clock frequency selection on CLK0, CLK3, and CLK5; FS\_1 can be used to control clock frequency selection on CLK1, CLK2, and CLK4. Any other combination is also possible. The frequency select feature is not available for CLKs 6 and 7.

The Si5350A uses control circuitry to ensure that frequency changes are glitchless. This ensures that the clock always completes its last cycle before starting a new clock cycle of a different frequency.

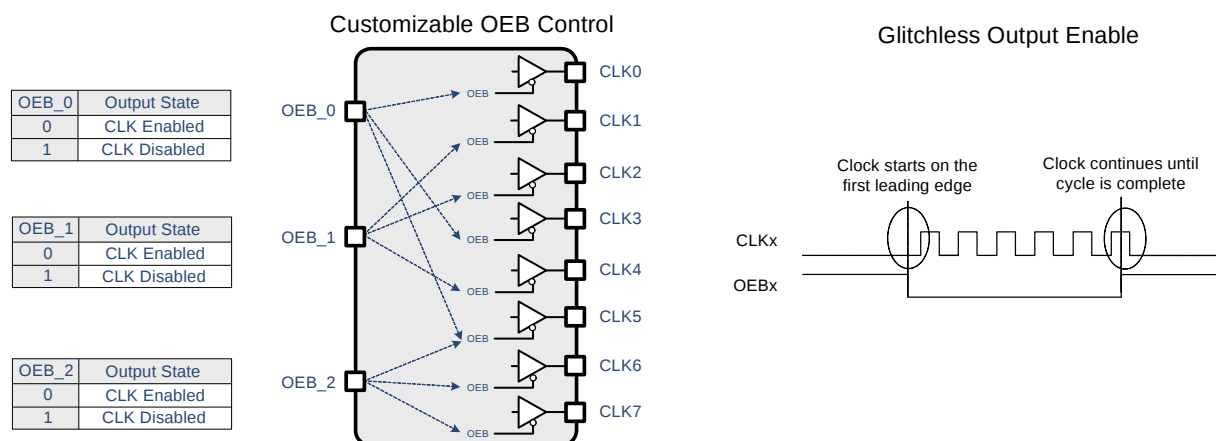


**Figure 8. Example Configuration of a Pin-Controlled Frequency Select (FS)**

#### 4.3.4. Output Enable (OEB\_0, OEB\_1, OEB\_2)

Up to three output enable pins (OEB\_0/1/2) are available on the Si5350A. Similar to the FS pins, each OEB pin can be linked to any of the output clocks. In the example shown in Figure 9, OEB\_0 is linked to control CLK0, CLK3, and CLK5; OEB\_1 is linked to control CLK6 and CLK7, and OEB\_2 is linked to control CLK1, CLK2, CLK4, and CLK5. Any other combination is also possible. If more than one OEB pin is linked to the same CLK output, the pin forcing a disable state will be dominant. Clock outputs are enabled when the OEB pin is held low.

The output enable control circuitry ensures glitchless operation by starting the output clock cycle on the first leading edge after OEB is asserted (OEB = low). When OEB is released (OEB = high), the clock is allowed to complete its full clock cycle before going into a disabled state. This is shown in Figure 9. When disabled, the output state is configurable as disabled high, disabled low, or disabled in high-impedance.



**Figure 9. Example Configuration of a Pin-Controlled Output Enable**

## 4.4. Design Considerations

The Si5350A is a self-contained clock generator that requires very few external components. The following general guidelines are recommended to ensure optimum performance.

### 4.4.1. Power Supply Decoupling/Filtering

The Si5350A has built-in power supply filtering circuitry to help keep the number of external components to a minimum. All that is recommended is one 0.1 to 1.0  $\mu\text{F}$  decoupling capacitor per power supply pin. This capacitor should be mounted as close to the VDD and VDDO pins as possible without using vias.

### 4.4.2. Power Supply Sequencing

The VDD and VDDOx (i.e., VDDO0, VDDO1, VDDO2, VDDO3) power supply pins have been separated to allow flexibility in output signal levels. Power supply sequencing for VDD and VDDOx requires that all VDDOx be powered up either before or at the same time as VDD. Unused VDDOx pins should be tied to VDD.

### 4.4.3. External Crystal

The external crystal should be mounted as close to the pins as possible using short PCB traces. The XA and XB traces should be kept away from other high-speed signal traces. See “AN551: Crystal Selection Guide” for more details.

### 4.4.4. External Crystal Load Capacitors

The Si5350A provides the option of using internal and external crystal load capacitors. If external load capacitors are used, they should be placed as close to the XA/XB pads as possible. See “AN551: Crystal Selection Guide” for more details.

### 4.4.5. Unused Pins

Unused control pins (P0–P4) should be tied to GND.

Unused output pins (CLK0–CLK7) should be left floating.

### 4.4.6. Trace Characteristics

The Si5350A features various output drive strength settings. It is recommended to configure the trace characteristics as shown in Figure 10 when the default high output drive setting is used.

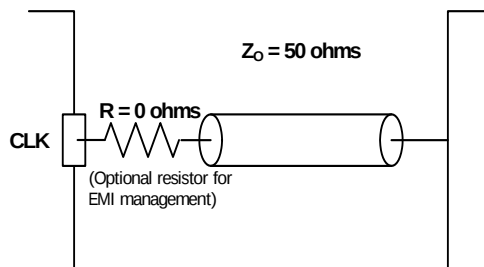


Figure 10. Recommended Trace Characteristics with Default Drive Strength Setting

## 5. Pin Descriptions

### 5.1. 20-pin QFN

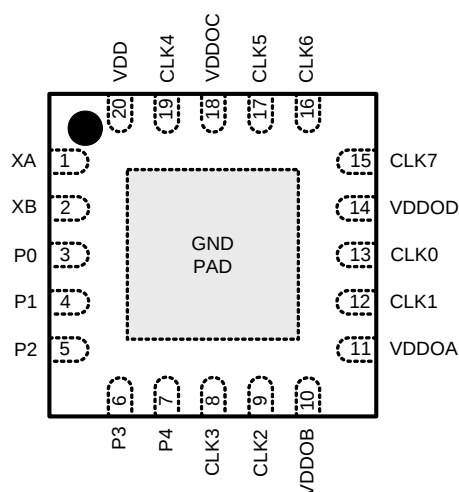


Figure 11. Si5350A 20-Pin QFN Top View

| Pin Name | Pin Number | Pin Type* | Function                                               |
|----------|------------|-----------|--------------------------------------------------------|
| XA       | 1          | I         | Input pin for external XTAL                            |
| XB       | 2          | I         | Input pin for external XTAL                            |
| CLK0     | 13         | O         | Output clock 0                                         |
| CLK1     | 12         | O         | Output clock 1                                         |
| CLK2     | 9          | O         | Output clock 2                                         |
| CLK3     | 8          | O         | Output clock 3                                         |
| CLK4     | 19         | O         | Output clock 4                                         |
| CLK5     | 17         | O         | Output clock 5                                         |
| CLK6     | 16         | O         | Output clock 6                                         |
| CLK7     | 15         | O         | Output clock 7                                         |
| P0       | 3          | I         | User configurable input pin 0. See 4.4.5.              |
| P1       | 4          | I         | User configurable input pin 1. See 4.4.5.              |
| P2       | 5          | I         | User configurable input pin 2. See 4.4.5.              |
| P3       | 6          | I         | User configurable input pin 3. See 4.4.5.              |
| P4       | 7          | I         | User configurable input pin 4. See 4.4.5.              |
| VDD      | 20         | P         | Core voltage supply pin. See 4.4.2                     |
| VDDOA    | 11         | P         | Output voltage supply pin for CLK0 and CLK1. See 4.4.2 |
| VDDOB    | 10         | P         | Output voltage supply pin for CLK2 and CLK3. See 4.4.2 |
| VDDOC    | 18         | P         | Output voltage supply pin for CLK4 and CLK5. See 4.4.2 |
| VDDOD    | 14         | P         | Output voltage supply pin for CLK6 and CLK7. See 4.4.2 |
| GND      | Center Pad | P         | Ground                                                 |

**\*Note:** I = Input, O = Output, P = Power

# Si5350A-B

## 5.2. 10-pin MSOP

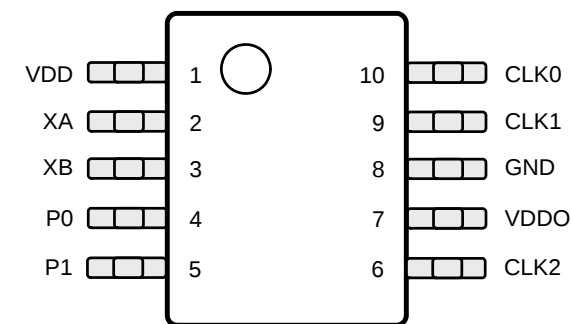
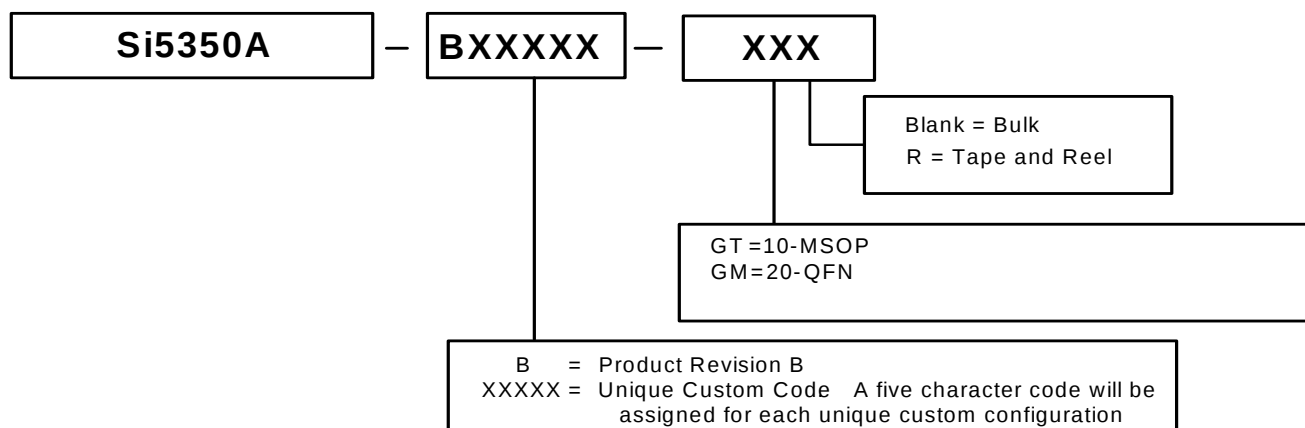


Figure 12. Si5350A 10-pin MSOP Top View

| Pin Name                                       | Pin Number | Pin Type* | Function                                                            |
|------------------------------------------------|------------|-----------|---------------------------------------------------------------------|
| XA                                             | 2          | I         | Input pin for external XTAL                                         |
| XB                                             | 3          | I         | Input pin for external XTAL                                         |
| CLK0                                           | 10         | O         | Output clock 0                                                      |
| CLK1                                           | 9          | O         | Output clock 1                                                      |
| CLK2                                           | 6          | O         | Output clock 2                                                      |
| P0                                             | 4          | I         | User configurable input pin 0                                       |
| P1                                             | 5          | I         | User configurable input pin 1                                       |
| VDD                                            | 1          | P         | Core voltage supply pin. See 4.4.2                                  |
| VDDO                                           | 7          | P         | Output clock voltage supply pin for CLK0, CLK1, and CLK2. See 4.4.2 |
| GND                                            | 8          | P         | Ground                                                              |
| <b>*Note:</b> I = Input, O = Output, P = Power |            |           |                                                                     |

## 6. Ordering Information

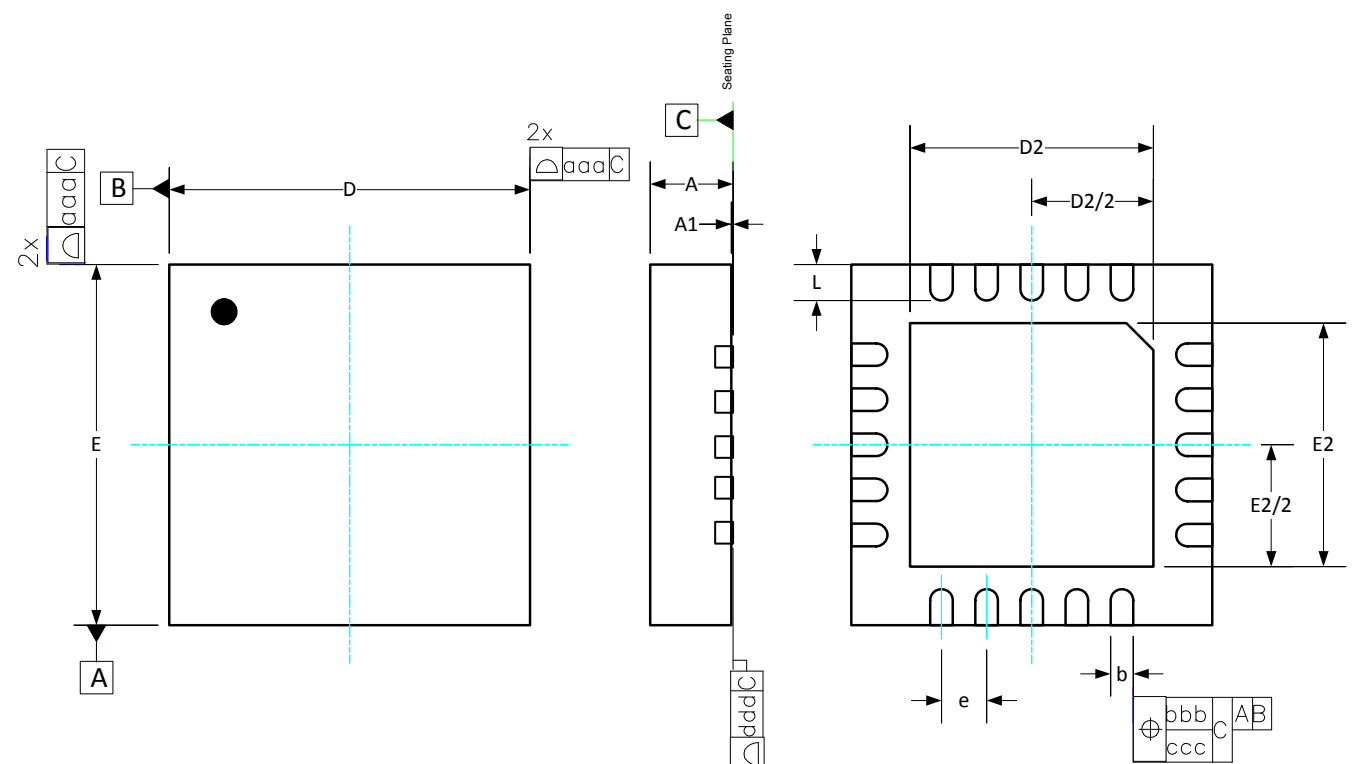
Factory programmed Si5350A devices can be requested using the ClockBuilder web-based utility available at: [www.silabs.com/ClockBuilder](http://www.silabs.com/ClockBuilder). A unique part number is assigned to each custom configuration as indicated in Figure 13. Use ClockBuilder to create custom part numbers or consult a Silicon Labs sales representative for other custom NVM configurations.



### Evaluation Boards

|                          |   |                                                  |
|--------------------------|---|--------------------------------------------------|
| <b>Si535x-TMSTK</b>      | – | For evaluation of<br>Si5350A-Bxxxxx-GT (10 MSOP) |
| <b>Si535x-B20QFN-EVB</b> | – | For evaluation of<br>Si5350A-Bxxxxx-GM (20 QFN)  |

Figure 13. Custom Clock Part Numbers



**Figure 14. 20-pin QFN Package Drawing**

**Table 11. Package Dimensions**

| <b>Dimension</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>Min</b> | <b>Nom</b> | <b>Max</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|
| A                                                                                                                                                                                                                                                                                                                                                                                                  | 0.80       | 0.85       | 0.90       |
| A1                                                                                                                                                                                                                                                                                                                                                                                                 | 0.00       | —          | 0.05       |
| b                                                                                                                                                                                                                                                                                                                                                                                                  | 0.20       | 0.25       | 0.30       |
| D                                                                                                                                                                                                                                                                                                                                                                                                  | 4.00 BSC   |            |            |
| D2                                                                                                                                                                                                                                                                                                                                                                                                 | 2.65       | 2.70       | 2.75       |
| e                                                                                                                                                                                                                                                                                                                                                                                                  | 0.50 BSC   |            |            |
| E                                                                                                                                                                                                                                                                                                                                                                                                  | 4.00 BSC   |            |            |
| E2                                                                                                                                                                                                                                                                                                                                                                                                 | 2.65       | 2.70       | 2.75       |
| L                                                                                                                                                                                                                                                                                                                                                                                                  | 0.35       | 0.40       | 0.45       |
| aaa                                                                                                                                                                                                                                                                                                                                                                                                | —          | —          | 0.10       |
| bbb                                                                                                                                                                                                                                                                                                                                                                                                | —          | —          | 0.10       |
| ccc                                                                                                                                                                                                                                                                                                                                                                                                | —          | —          | 0.08       |
| ddd                                                                                                                                                                                                                                                                                                                                                                                                | —          | —          | 0.10       |
| <b>Notes:</b> <ol style="list-style-type: none"><li>1. All dimensions shown are in millimeters (mm) unless otherwise noted.</li><li>2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.</li><li>3. This drawing conforms to JEDEC Outline MO-220, variation VGGD-5.</li><li>4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.</li></ol> |            |            |            |

8. Land Pattern: 20-Pin QFN

Figure 15 shows the recommended land pattern details for the Si5350 in a 20-Pin QFN package. Table 12 lists the values for the dimensions shown in the illustration.

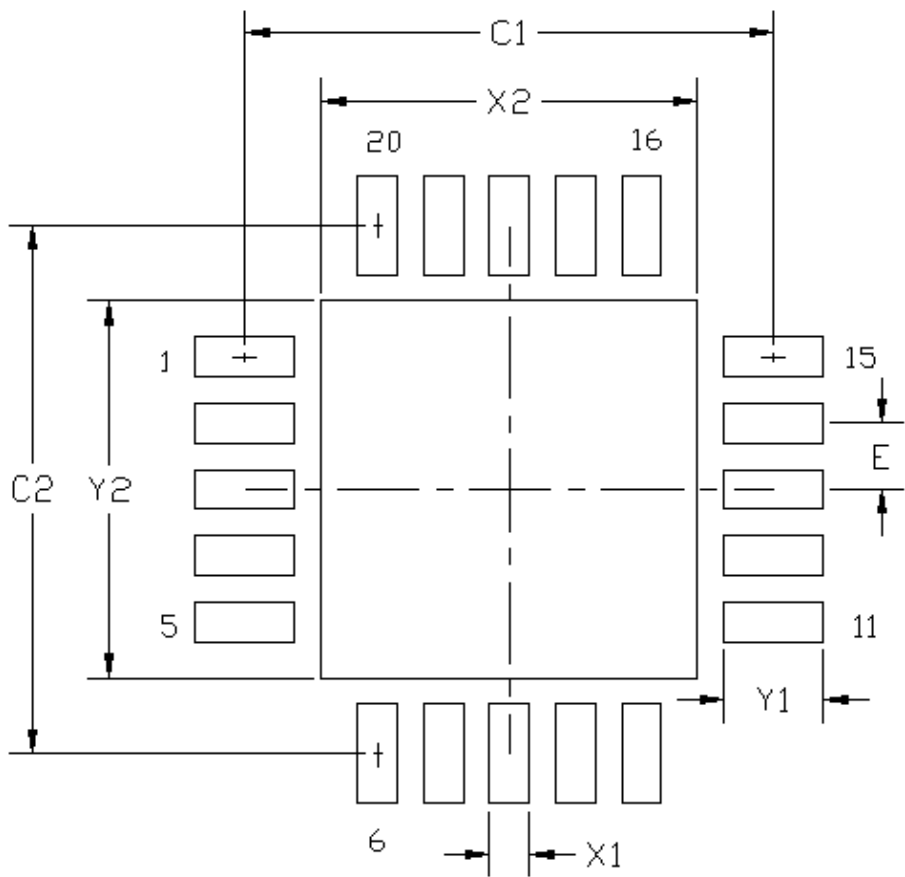


Figure 15. 20-Pin QFN Land Pattern

**Table 12. PCB Land Pattern Dimensions**

| Symbol | Millimeters |
|--------|-------------|
| C1     | 4.0         |
| C2     | 4.0         |
| E      | 0.50 BSC    |
| X1     | 0.30        |
| X2     | 2.70        |
| Y1     | 0.80        |
| Y2     | 2.70        |

**Notes:****General**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. This land pattern design is based on IPC-7351 guidelines.

**Solder Mask Design**

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

**Stencil Design**

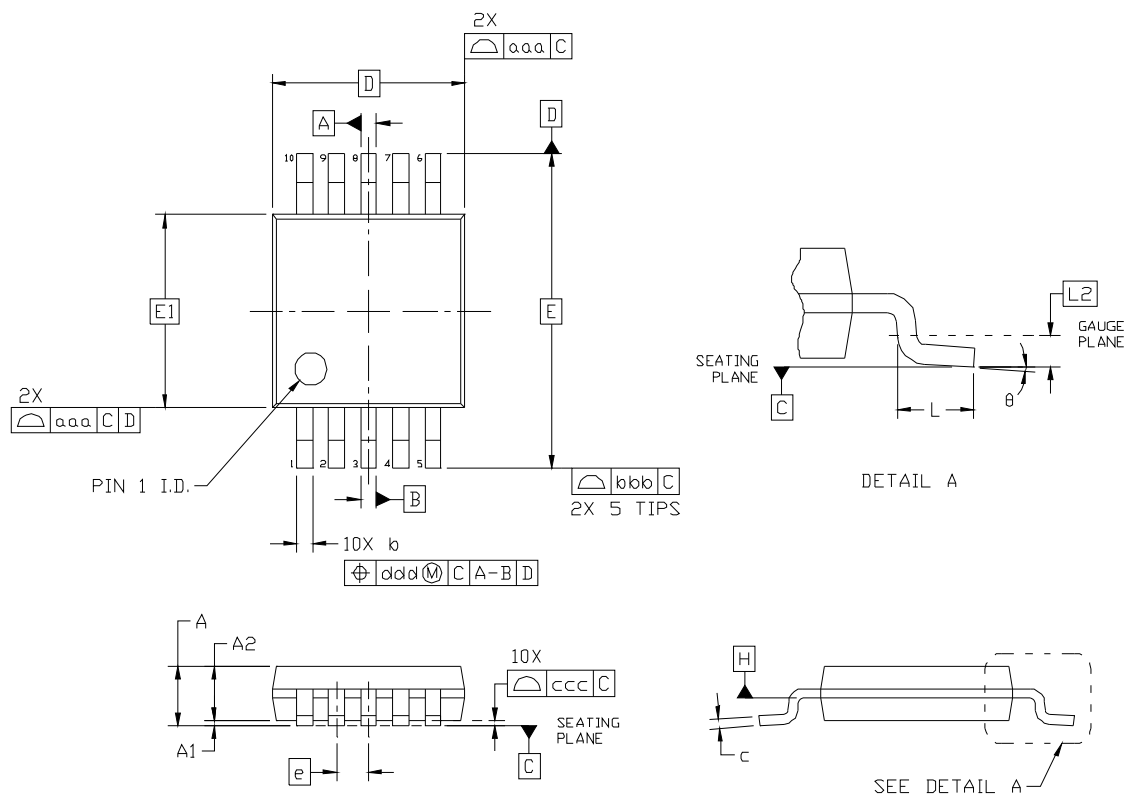
4. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
5. The stencil thickness should be 0.125 mm (5 mils).
6. The ratio of stencil aperture to land pad size should be 1:1 for all perimeter pads.
7. A 2x2 array of 1.10 x 1.10 mm openings on 1.30 mm pitch should be used for the center ground pad.

**Card Assembly**

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

## 9. 10-pin MSOP Package Outline

Figure 16 illustrates the package details for the Si5350A-B in a 10-pin MSOP package. Table 13 lists the values for the dimensions shown in the illustration.



**Figure 16. 10-pin MSOP Package Drawing**

Table 13. 10-MSOP Package Dimensions

| Dimension                                                                                                                                                                                                                                                                                                                                                                                                         | Min      | Nom  | Max  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------|
| A                                                                                                                                                                                                                                                                                                                                                                                                                 | —        | —    | 1.10 |
| A1                                                                                                                                                                                                                                                                                                                                                                                                                | 0.00     | —    | 0.15 |
| A2                                                                                                                                                                                                                                                                                                                                                                                                                | 0.75     | 0.85 | 0.95 |
| b                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.17     | —    | 0.33 |
| c                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.08     | —    | 0.23 |
| D                                                                                                                                                                                                                                                                                                                                                                                                                 | 3.00 BSC |      |      |
| E                                                                                                                                                                                                                                                                                                                                                                                                                 | 4.90 BSC |      |      |
| E1                                                                                                                                                                                                                                                                                                                                                                                                                | 3.00 BSC |      |      |
| e                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.50 BSC |      |      |
| L                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.40     | 0.60 | 0.80 |
| L2                                                                                                                                                                                                                                                                                                                                                                                                                | 0.25 BSC |      |      |
| q                                                                                                                                                                                                                                                                                                                                                                                                                 | 0        | —    | 8    |
| aaa                                                                                                                                                                                                                                                                                                                                                                                                               | —        | —    | 0.20 |
| bbb                                                                                                                                                                                                                                                                                                                                                                                                               | —        | —    | 0.25 |
| ccc                                                                                                                                                                                                                                                                                                                                                                                                               | —        | —    | 0.10 |
| ddd                                                                                                                                                                                                                                                                                                                                                                                                               | —        | —    | 0.08 |
| <b>Notes:</b> <ol style="list-style-type: none"> <li>1. All dimensions shown are in millimeters (mm) unless otherwise noted.</li> <li>2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.</li> <li>3. This drawing conforms to the JEDEC Solid State Outline MO-137, Variation C</li> <li>4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.</li> </ol> |          |      |      |

## 10. Land Pattern: 10-Pin MSOP

Figure 17 shows the recommended land pattern details for the Si5350A-B in a 10-Pin MSOP package. Table 14 lists the values for the dimensions shown in the illustration.

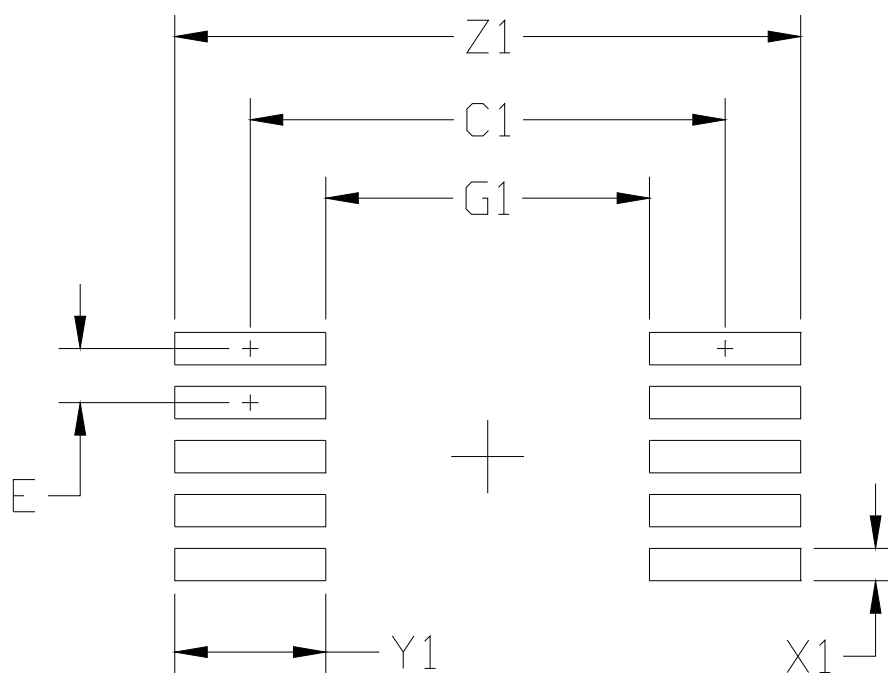


Figure 17. 10-Pin MSOP Land Pattern

Table 14. PCB Land Pattern Dimensions

| Symbol | Millimeters |      |
|--------|-------------|------|
|        | Min         | Max  |
| C1     | 4.40 REF    |      |
| E      | 0.50 BSC    |      |
| G1     | 3.00        | —    |
| X1     | —           | 0.30 |
| Y1     | 1.40 REF    |      |
| Z1     | —           | 5.80 |

**Notes:****General**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ASME Y14.5M-1994.
3. This Land Pattern Design is based on the IPC-7351 guidelines.
4. All dimensions shown are at Maximum Material Condition (MMC). Least Material Condition (LMC) is calculated based on a Fabrication Allowance of 0.05mm.

**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  $\mu$ 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.

**Card Assembly**

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

## 11. Top Marking

### 11.1. 20-Pin QFN Top Marking

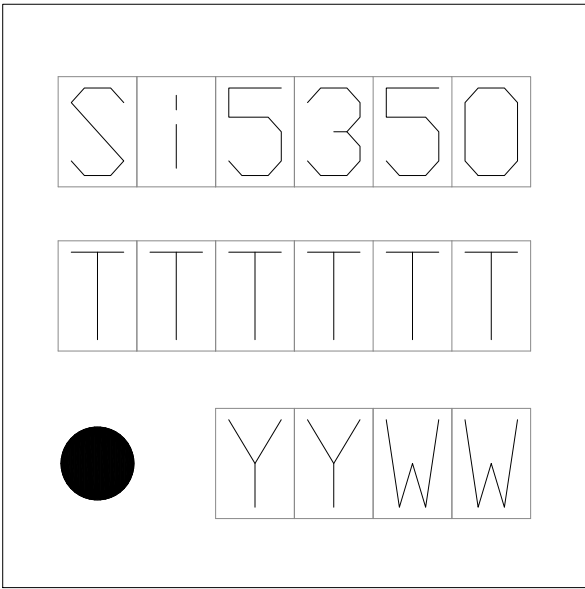


Figure 18. 20-Pin QFN Top Marking

### 11.2. Top Marking Explanation

|                                                                                                                                                                                       |                                                       |                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Mark Method:                                                                                                                                                                          | Laser                                                 |                                                                                             |
| Pin 1 Mark:                                                                                                                                                                           | Filled Circle = 0.50 mm Diameter (Bottom-Left Corner) |                                                                                             |
| Font Size:                                                                                                                                                                            | 0.60 mm (24 mils)                                     |                                                                                             |
| Line 1 Mark Format                                                                                                                                                                    | Device Part Number                                    | Si5350                                                                                      |
| Line 2 Mark Format:                                                                                                                                                                   | TTTTTT = Mfg Code*                                    | Manufacturing Code from the Assembly Purchase Order Form.                                   |
| Line 3 Mark Format:                                                                                                                                                                   | YY = Year<br>WW = Work Week                           | Assigned by the Assembly House. Corresponds to the year and work week of the assembly date. |
| <b>*Note:</b> The code shown in the “TTTTTT” line does not correspond to the orderable part number or frequency plan. It is used for package assembly quality tracking purposes only. |                                                       |                                                                                             |

### 11.3. 10-Pin MSOP Top Marking

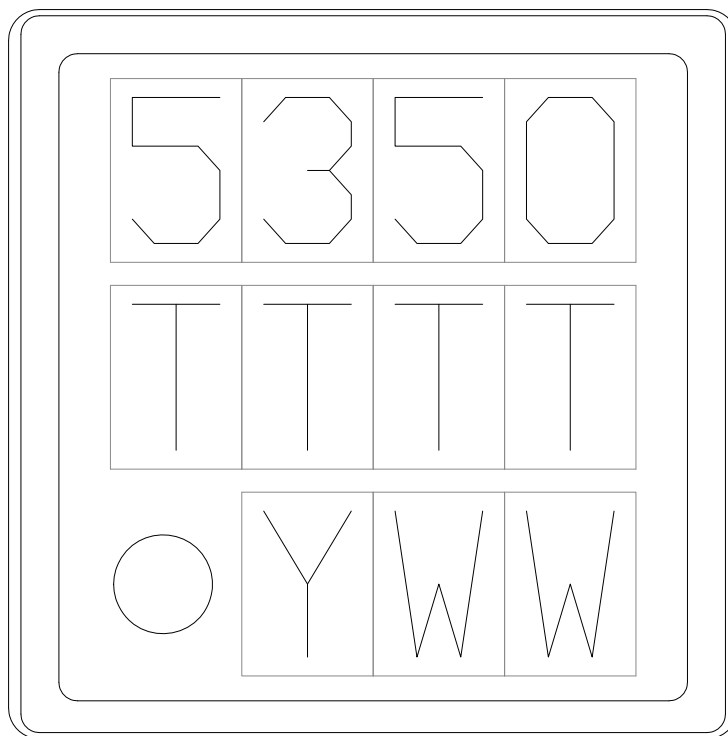


Figure 19. 10-Pin MSOP Top Marking

### 11.4. Top Marking Explanation

|                                                                                                                                                                                     |                                  |                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Mark Method:</b>                                                                                                                                                                 | Laser                            |                                                                                                                      |
| <b>Pin 1 Mark:</b>                                                                                                                                                                  | Mold Dimple (Bottom-Left Corner) |                                                                                                                      |
| <b>Font Size:</b>                                                                                                                                                                   | 0.60 mm (24 mils)                |                                                                                                                      |
| <b>Line 1 Mark Format</b>                                                                                                                                                           | Device Part Number               | Si5350                                                                                                               |
| <b>Line 2 Mark Format:</b>                                                                                                                                                          | TTTT = Mfg Code*                 | Line 2 from the “Markings” section of the Assembly Purchase Order form.                                              |
| <b>Line 3 Mark Format:</b>                                                                                                                                                          | YWW = Date Code                  | Assigned by the Assembly House.<br>Y = Last Digit of Current Year (Ex: 2013 = 3)<br>WW = Work Week of Assembly Date. |
| <b>*Note:</b> The code shown in the “TTTT” line does not correspond to the orderable part number or frequency plan. It is used for package assembly quality tracking purposes only. |                                  |                                                                                                                      |

## DOCUMENT CHANGE LIST

### Revision 0.75 to Revision 1.0

- Extended frequency range from 8 MHz-160 MHz to 2.5 kHz-200 MHz.
- Added 1.8 V VDD support.
- Updated block diagrams for clarity.
- Added complete Si5350/1 family table, Table 1.
- Added top mark information.
- Added land pattern drawings.
- Added PowerUp Time, PLL Bypass mode, Table 4.
- Clarified Down Spread step sizes in Table 4.
- Updated max jitter specs (typ unchanged) in Table 6.
- Clarified power supply sequencing requirement, Section 4.4.2.



## ClockBuilder Pro

One-click access to Timing tools, documentation, software, source code libraries & more. Available for Windows and iOS (CBGo only).

[www.silabs.com/CBPro](http://www.silabs.com/CBPro)



**Timing Portfolio**  
[www.silabs.com/timing](http://www.silabs.com/timing)



**SW/HW**  
[www.silabs.com/CBPro](http://www.silabs.com/CBPro)



**Quality**  
[www.silabs.com/quality](http://www.silabs.com/quality)



**Support and Community**  
[community.silabs.com](http://community.silabs.com)

### Disclaimer

Silicon Laboratories intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Laboratories products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications. Application examples described herein are for illustrative purposes only. Silicon Laboratories reserves the right to make changes without further notice and limitation to product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Silicon Laboratories shall have no liability for the consequences of use of the information supplied herein. This document does not imply or express copyright licenses granted hereunder to design or fabricate any integrated circuits. The products must not be used within any Life Support System without the specific written consent of Silicon Laboratories. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Laboratories products are generally not intended for military applications. Silicon Laboratories products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons.

### Trademark Information

Silicon Laboratories Inc., Silicon Laboratories, Silicon Labs, SiLabs and the Silicon Labs logo, CMEMS®, EFM, EFM32, EFR, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Ember®, EZLink®, EZMac®, EZRadio®, EZRadioPRO®, DSPLL®, ISOModem®, Precision32®, ProSLIC®, SiPHY®, USBXpress® and others are trademarks or registered trademarks of Silicon Laboratories Inc. ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings. Keil is a registered trademark of ARM Limited. All other products or brand names mentioned herein are trademarks of their respective holders.



Silicon Laboratories Inc.  
400 West Cesar Chavez  
Austin, TX 78701  
USA

<http://www.silabs.com>