Si5350C-B

Factory-Programmable Any-Frequency CMOS Clock Generator + PLL

Features

- https://www.skyworksinc.com/Products/Timing/CMOS-Clock-Generators
- 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)
  - Loss of Lock Status (LOLB)
- 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: 1.8V, 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 three packages types:
  - 10-MSOP: 3 outputs
  - 16-QFN (3x3 mm): 4 output
  - 20-QFN (4x4 mm): 8 output
- PCIE Gen 1 compliant
- Supports HCSL compatible swing

10-MSOP



16-QFN



20-QFN



Ordering Information:
See page 22

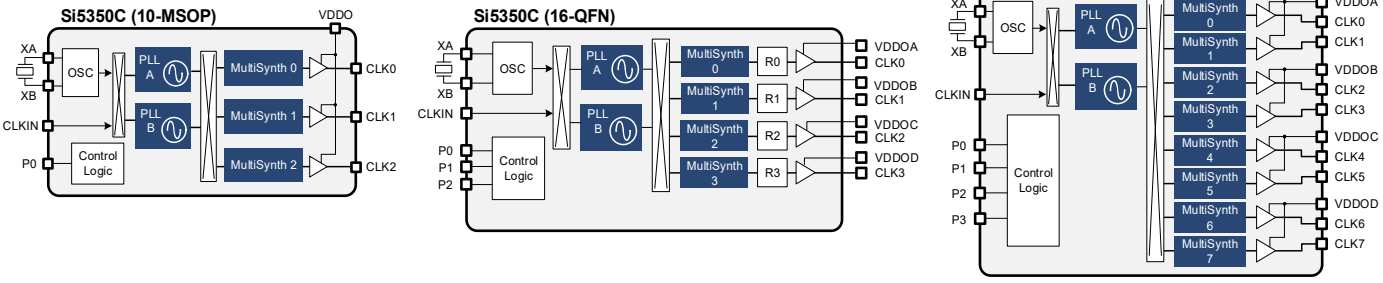
Applications

- 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 Si5350C generates free-running and/or synchronized clocks selectable on each of its outputs. A dual PLL + high resolution MultiSynth™ fractional divider architecture enables this user-definable custom timing device to generate any of the specified output frequencies at any of its outputs. This allows the Si5350C to replace a combination of crystals, crystal oscillators, and synchronized clocks (PLL). Custom Si5350C configurations can be created using ClockBuilder Pro.

Functional Block Diagram



1. Ordering Guide

Table 1. Complete Si5350/51 Clock Generator Family

Part Number	I²C or Pin	Frequency Reference	Programmed?	Outputs	Data Sheet
Si5351A-B-GT	I²C	XTAL only	Blank	3	Si5351A/B/C-B
Si5351A-B-GM1	I²C	XTAL only	Blank	4	Si5351A/B/C-B
Si5351B-B-GM1	I²C	XTAL and/or Voltage	Blank	4	Si5351A/B/C-B
Si5351C-B-GM1	I²C	XTAL and/or CLKIN	Blank	4	Si5351A/B/C-B
Si5351A-B-GM	I²C	XTAL only	Blank	8	Si5351A/B/C-B
Si5351B-B-GM	I²C	XTAL and/or Voltage	Blank	8	Si5351A/B/C-B
Si5351C-B-GM	I²C	XTAL and/or CLKIN	Blank	8	Si5351A/B/C-B
Si5351A-Bxxxxx-GT	I²C	XTAL only	Factory Preprogrammed	3	Si5351A/B/C-B
Si5351A-Bxxxxx-GM1	I²C	XTAL only	Factory Preprogrammed	4	Si5351A/B/C-B
Si5351B-Bxxxxx-GM1	I²C	XTAL and/or Voltage	Factory Preprogrammed	4	Si5351A/B/C-B
Si5351C-Bxxxxx-GM1	I²C	XTAL and/or CLKIN	Factory Preprogrammed	4	Si5351A/B/C-B
Si5351A-Bxxxxx-GM	I²C	XTAL only	Factory Preprogrammed	8	Si5351A/B/C-B
Si5351B-Bxxxxx-GM	I²C	XTAL and/or Voltage	Factory Preprogrammed	8	Si5351A/B/C-B
Si5351C-Bxxxxx-GM	I²C	XTAL and/or CLKIN	Factory Preprogrammed	8	Si5351A/B/C-B
Si5350A-Bxxxxx-GT	Pin	XTAL only	Factory Preprogrammed	3	Si5350A-B
Si5350A-Bxxxxx-GM1	Pin	XTAL only	Factory Preprogrammed	4	Si5350A-B
Si5350A-Bxxxxx-GM	Pin	XTAL only	Factory Preprogrammed	8	Si5350A-B
Si5350B-Bxxxxx-GT	Pin	XTAL and/or Voltage	Factory Preprogrammed	3	Si5350B-B
Si5350B-Bxxxxx-GM1	Pin	XTAL and/or Voltage	Factory Preprogrammed	4	Si5350B-B
Si5350B-Bxxxxx-GM	Pin	XTAL and/or Voltage	Factory Preprogrammed	8	Si5350B-B
Si5350C-Bxxxxx-GT	Pin	XTAL and/or CLKIN	Factory Preprogrammed	3	Si5350C-B
Si5350C-Bxxxxx-GM1	Pin	XTAL and/or CLKIN	Factory Preprogrammed	4	Si5350C-B
Si5350C-Bxxxxx-GM	Pin	XTAL and/or CLKIN	Factory Preprogrammed	8	Si5350C-B

2. Technical Support Resources

Table 2. Technical Support Resources

Resource	URL
Si5350/51 Frequently Asked Questions	https://www.skyworksinc.com/en/Products/Timing
ClockBuilder Pro (CBPro) Software	https://www.skyworksinc.com/en/Application-Pages/Clockbuilder-Pro-Software
Si535x Development Kits	https://www.skyworksinc.com/en/Products/Timing/Evaluation-Kits/si535x-b20qfn-evb-evaluation-kit

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3. Electrical Specifications

Table 3. Recommended Operating Conditions

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Ambient Temperature	T_A		–40	25	85	°C
Core Supply Voltage	V_{DD}		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_{DDOx}		1.71	1.8	1.89	V
			2.25	2.5	2.75	V
			3.0	3.3	3.60	V
Note: All minimum and maximum specifications are guaranteed and apply across the recommended operating conditions. Typical values apply at nominal supply voltages and an operating temperature of 25 °C unless otherwise noted. 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 4. DC Characteristics

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Core Supply Current*	I_{DD}	Enabled 3 outputs	—	20	35	mA
		Enabled 4 outputs	—	21	38	mA
		Enabled 8 outputs	—	25	45	mA
		Power Down (PDN = V_{DD})	—	—	50	µA
Output Buffer Supply Current (Per Output)*	I_{DDOx}	C_L = 5 pF	—	2.2	5.6	mA
Input Current	I_{P1-P3}	Pins P1, P2, P3 V_{P1-P3} < 3.6 V	—	—	10	µA
	I_{P0}	Pin P0	—	—	30	µA
Output Impedance	Z_{OI}	3.3 V VDDO, default high drive.	—	50	—	Ω
***Note:** Output clocks less than or equal to 100 MHz.						

Table 5. AC Characteristics

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Power-Up Time	T_{RDY}	From V_{DD} = V_{DDmin} to valid output clock, C_L = 5 pF, f_{CLKn} > 1 MHz	—	2	10	ms
Powerup Time, PLL Bypass Mode	T_{BYP}	From V_{DD} = V_{DDmin} to valid output clock, C_L = 5 pF, f_{CLKn} > 1 MHz	—	0.5	1	ms
Output Enable Time	T_{OE}	From OEB assertion to valid clock output, C_L = 5 pF, f_{CLKn} > 1 MHz	—	—	10	µs
Output Frequency Transition Time	T_{FREQ}	f_{CLKn} > 1 MHz	—	—	10	µs
Spread Spectrum Frequency Deviation	SS_{DEV}	Down spread. Selectable in 0.1% steps.	–0.1	—	–2.5	%
		Center spread. Selectable in 0.1% steps.	±0.1	—	±1.5	%
Spread Spectrum Modulation Rate	SS_{MOD_C}		30	31.5	33	kHz

Table 6. Input Characteristics

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Crystal Frequency	f_{XTAL}		25	—	27	MHz
P0-P3 Input Low Voltage	V_{IL_P0-3}		–0.1	—	0.3 x V_{DD}	V
P0-P3 Input High Voltage	V_{IH_P0-3}	V_{DD} = 2.5 V or 3.3 V	0.7 x V_{DD}	—	3.60	V
		V_{DD} = 1.8 V	0.8 x V_{DD}	—	3.60	V
CLKIN Frequency Range	f_{CLKIN}		10	—	100	MHz
CLKIN Input Low Voltage	V_{IL_CLKIN}		–0.1	—	0.3 x V_{DD}	V
CLKIN Input High Voltage	V_{IH_CLKIN}		0.7 x V_{DD}	—	3.60	V

Table 7. Output Characteristics

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency Range[1]	F_{CLK}		0.0025	—	200	MHz
Load Capacitance	C_L	F_{CLK} < 100 MHz	—	—	15	pF
Duty Cycle	DC	F_{CLK} ≤ 160 MHz, Measured at $V_{DD}/2$	45	50	55	%
		F_{CLK} > 160 MHz, Measured at $V_{DD}/2$	40	50	60	%
Rise/Fall Time	t_r/t_f	20%–80%, C_L = 5 pF	—	1	1.5	ns
Output High Voltage	V_{OH}	C_L = 5 pF	V_{DD} – 0.6	—	—	V
Output Low Voltage	V_{OL}		—	—	0.6	V
Period Jitter[2,3]	J_{PER}	16, 20-QFN, 4 outputs running, 1 per VDDO	-	40	95	ps, pk-pk
		10-MSOP or 20-QFN, all outputs running	-	70	155	ps, pk-pk
Cycle-to-cycle Jitter[2,3]	J_{CC}	16, 20-QFN, 4 outputs running, 1 per VDDO	—	50	90	ps, pk
		10-MSOP or 20-QFN, all outputs running	—	70	150	ps, pk

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. Four-output, 16-QFN package measured with clock outputs of 33.333, 27, 28.322, and 48 MHz.

Table 8. 25 MHz Crystal Requirements[1,2]

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	Ω
Crystal Max Drive Level	d_L	100	—	—	µW

Notes:
1. Crystals which require load capacitances of 6, 8, or 10 pF should use the device’s internal load capacitance for optimum performance. 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 4 pF capacitors on XA and XB). ClockBuilder Pro can be used to configure the internal load capacitors.
2. Refer to “AN551: Crystal Selection Guide” for more details.

Table 9. 27 MHz Crystal Requirements[1,2]

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	Ω
Crystal Max Drive Level	d_L	100	—	—	µW

Notes:
1. Crystals which require load capacitances of 6, 8, or 10 pF should use the device's internal load capacitance for optimum performance. 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 4 pF capacitors on XA and XB). ClockBuilder Pro can be used to configure the internal load capacitors.
2. Refer to "AN551: Crystal Selection Guide" for more details.

Table 10. Thermal Characteristics (2-Layer Board)

Parameter	Symbol	Test Condition	Package	Value	Unit
Thermal Resistance Junction to Ambient	θ_{JA}	Still Air[1]	10-MSOP	150	°C/W
			16-QFN	103	°C/W
			20-QFN	74.9	°C/W
Thermal Resistance Junction to Board	Ψ_{JB}	Still Air[1]	10-MSOP	82	°C/W
			16-QFN	37	°C/W
			20-QFN	9.94	°C/W
Thermal Resistance Junction to Top Center	Ψ_{JT}	Still Air[1]	10-MSOP	0.84	°C/W
			16-QFN	4.26	°C/W
			20-QFN	1.3	°C/W

Notes:
1. Based on environment and board designed per JESD51-2A and JESD51-3.

Table 11. Thermal Characteristics (4-Layer Board)

Parameter	Symbol	Test Condition	Package	Value	Unit
Thermal Resistance Junction to Ambient	θ_{JA}	Still Air[1]	10-MSOP	126	°C/W
			16-QFN	65	°C/W
			20-QFN	41	°C/W
Thermal Resistance Junction to Board	θ_{JB}	Junction to Board[2]	10-MSOP	84	°C/W
			16-QFN	48	°C/W
			20-QFN	16	°C/W
	Ψ_{JB}	Still Air[1]	10-MSOP	83	°C/W
			16-QFN	31	°C/W
			20-QFN	8.1	°C/W
Thermal Resistance Junction to Top Center	Ψ_{JT}	Still Air[1]	10-MSOP	0.74	°C/W
			16-QFN	3.8	°C/W
			20-QFN	0.98	°C/W

Notes:
1. Based on environment and board designed per JESD51-2A, JESD51-5, and JESD51-7.
2. Based on conditions set in JESD51-8.

Table 12. Thermal Characteristics (Junction-to-Case)

Parameter	Symbol	Test Condition	Package	Value	Unit
Thermal Resistance Junction to Case[1]	θ_{JC}	Still Air	10-MSOP	36	°C/W
			16-QFN	82	°C/W
			20-QFN	51	°C/W

Notes:
1. Based on board designed per JESD51-1 (Top center of packages used).

Table 13. Absolute Maximum Ratings[1]

Parameter	Symbol	Test Condition	Value	Unit
DC Supply Voltage	V_{DD_max}		–0.5 to 3.8	V
Input Voltage	V_{IN_CLKIN}	CLKIN	–0.5 to 3.8	V
	V_{IN_P1-3}	Pins P1, P2, P3	–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
Soldering Temperature (Pb-free profile)[2]	T_{PEAK}		260	°C
Soldering Temperature Time at T_{PEAK} (Pb-free profile)[2]	T_P		20–40	Sec

Notes:
1. 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. The device is compliant with JEDEC J-STD-020.

4. Typical Application

4.1. Si5350C Replaces Multiple Clocks and XOs

The Si5350C is a clock generation device that provides both synchronous and free-running clocks for applications where power, board size, and cost are critical. An example application is shown in Figure 1. Any other combination is possible.

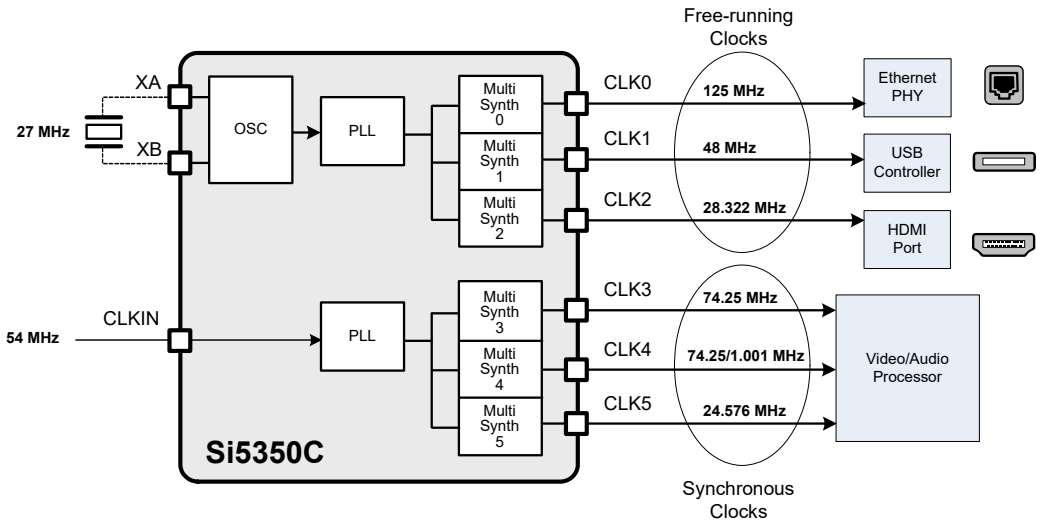
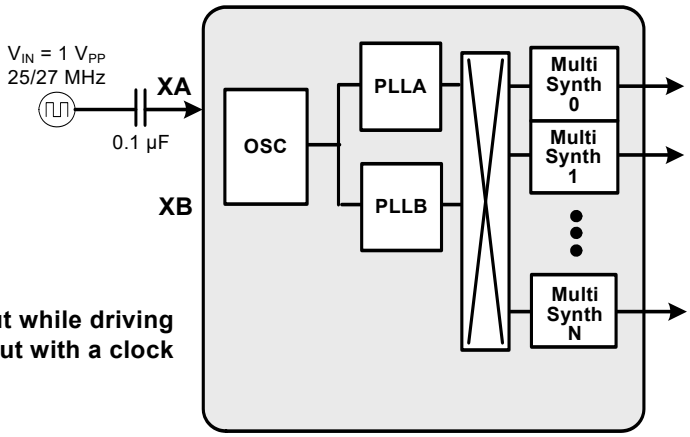


Figure 1. Replacing multiple XTAL/XOs and PLLs with one Si5350C

4.2. Applying a Reference Clock at XTAL Input

The Si5350C can be driven with a clock signal through the XA input pin. This is especially useful when in need of generating clock outputs in two synchronization domains; one reference clock can be provided at the CLKIN pin and at XA.



Note: Float the XB input while driving the XA input with a clock

Figure 2. Si5350C Driven by a Clock Signal

4.3. HCSL Compatible Outputs

The Si5350C 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 the figure below 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. This functionality is only supported for the Si5350C in 10-MSOP or 20-QFN packages.

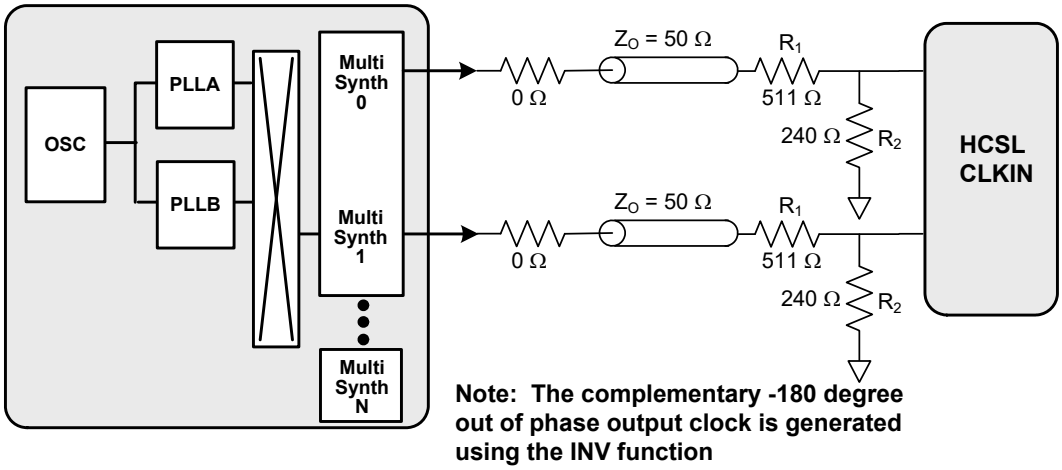


Figure 3. Si5350C Output is HCSL Compatible

5. Functional Description

The architecture of the Si5350C generates up to eight non-integer-related frequencies in any combination of free-running and/or synchronous clocks. A block diagram of the 3-, 4-, and 8-output versions shown in Figure 4. Free-running clocks are generated using the on-chip oscillator + PLL, and the clock input pin (CLKIN) provides an external input reference for the synchronous clocks. Each MultiSynth™ is configurable with two frequencies (F1_x, F2_x). This allows a pin controlled glitchless frequency change at each output (CLK0 to CLK2).

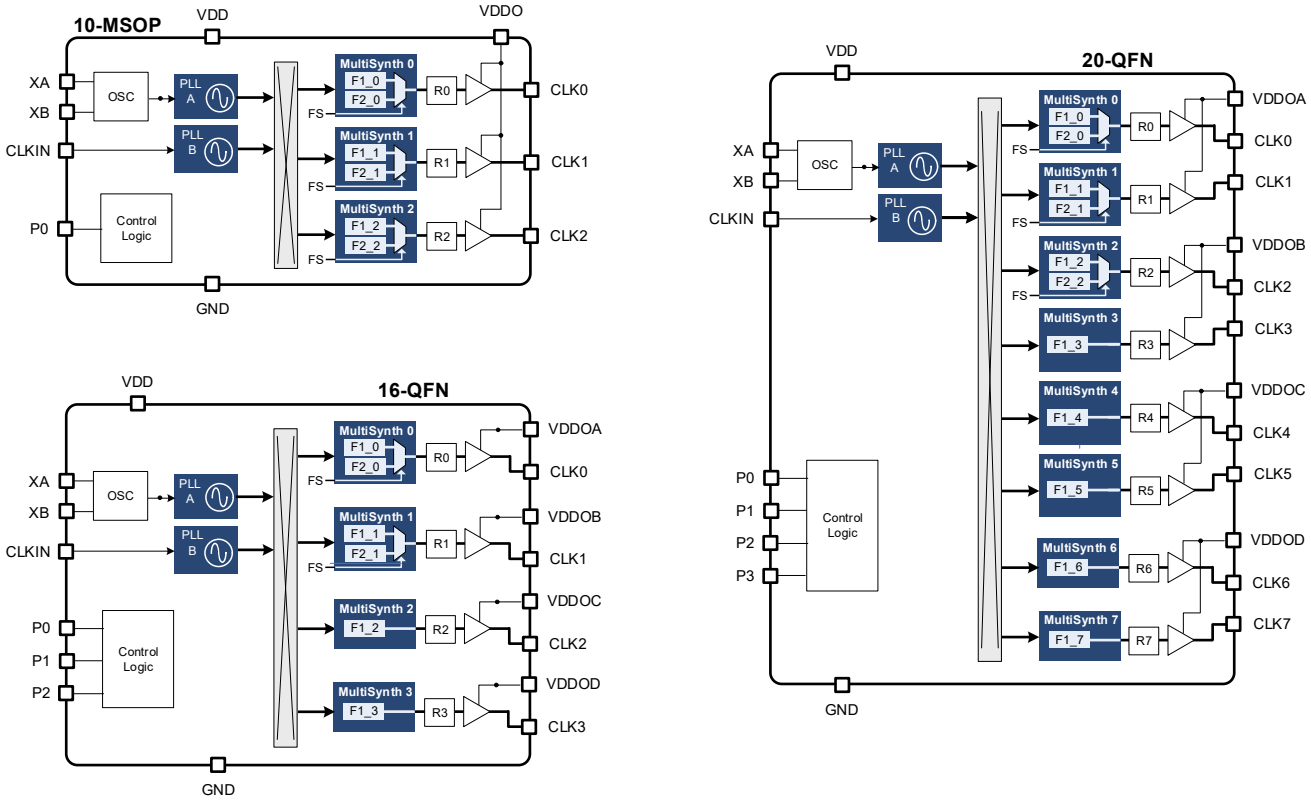


Figure 4. Block Diagrams of 3-Output, 4-Output, and 8-Output Si5350C Devices

6. Configuring the Si5350C

The Si5350C is a factory-programmed custom clock generator that is user-definable with ClockBuilder Pro, which provides a simple graphical interface that allows users 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 Pro to ensure an optimum configuration. A unique part number is assigned to each custom configuration.

6.1. Crystal Inputs (XA, XB)

The Si5350C uses an optional fixed-frequency non-pullable standard AT-cut crystal as a reference to generate free-running output clocks. Note that a XTAL is not required for generating synchronous clocks that are locked to CLKIN.

6.1.1. Crystal Frequency

The Si5350C can operate using either a 25 MHz or a 27 MHz crystal.

6.1.2. Internal XTAL Load Capacitors

Internal load capacitors are provided to eliminate the need for external components when connecting a XTAL to the Si5350C. 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 ≤ 2 pF (e.g., by using ≤ 4 pF capacitors on XA and XB) as shown in Figure 5.

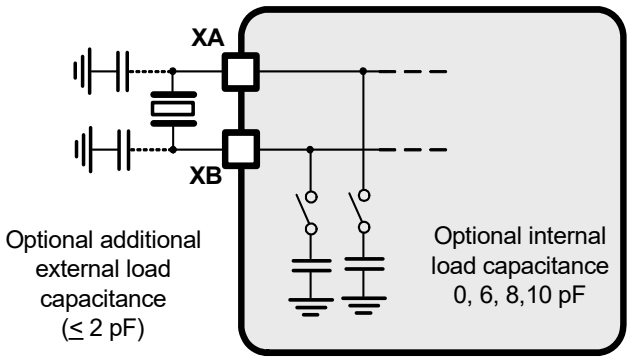


Figure 5. External XTAL with Optional Load Capacitors

6.2. External Clock Input Pin (CLKIN)

The external clock input is used as a reference for generating synchronous clocks. The input frequency can be specified from 10 to 100 MHz including fractional frequencies (e.g., 74.25 MHz x 1000/1001). The ClockBuilder utility automatically determines the exact synthesis ratio to guarantee an output frequency with 0 ppm error with respect to its reference.

6.3. Output Clocks (CLK0–CLK7)

The Si5350C is orderable as a 3-output (10-MSOP), 4-output (16-QFN), or 8-output (20-QFN) clock generator. Output clocks CLK0 to CLK2 can be ordered with two clock frequencies (F1_x, F2_x) which are selectable with the optional frequency select pins (FS0/1). See “6.4.3. Frequency Select (FS_0, FS_1)” for more details on the operation of the frequency select pins. Each output clock can select its reference for either of the PLLs.

6.3.1. 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).

6.3.2. 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 Si5350C supports several levels of spread spectrum allowing the designer to choose an ideal compromise between system performance and EMI compliance. If the CLKIN pin already has spread spectrum applied to it, it will get passed through to the outputs that are referenced to it. In this case, do not configure the synchronous outputs for spread spectrum as the device will erroneously try to add additional spread to them.

An optional spread spectrum enable pin (SSEN) is configurable to enable or disable the spread spectrum feature. See “6.4.1. Spread Spectrum Enable (SSEN)” for details.

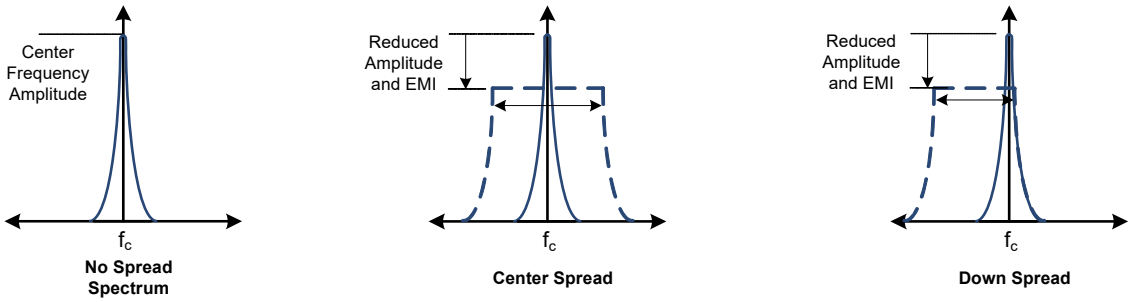


Figure 6. Available Spread Spectrum Profiles

6.3.3. 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.

6.3.4. Output State When Disabled

There are up to three output enable pins configurable on the Si5350C as described in “6.4.4. 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.

6.3.5. Powering Down Unused Outputs

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

6.4. Programmable Control Pins (P0–P3) Options

Up to four programmable control pins (P0-P3) are configurable allowing direct pin control of the following features:

6.4.1. 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.

6.4.2. Power Down (PDN)

An optional power down control pin allows a full shutdown of the Si5350C to minimize power consumption when its output clocks are not being used. The Si5350C 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 4 on page 5.

6.4.3. Frequency Select (FS_0, FS_1)

The Si5350C offers the option of configuring up to two frequencies per clock output (CLK0–CLK2) for either free-running or synchronous clocks. This is a useful feature for applications that need to support more than one free-running or synchronous clock rate on the same output. An example of this is shown in Figure 7. The FS pins select which frequency is generated from the clock output. In this example, FS0 selects the output frequency on CLK0 and FS1 selects the frequency on CLK1.

FS0 Bit Level	Free-running Frequency
0	F1_0: 74.25 MHz
1	F2_0: $\frac{74.25}{1.001}$ MHz

FS1 Bit Level	Synchronous Frequency
0	F1_1: 24.576 MHz
1	F2_1: 22.5792 MHz

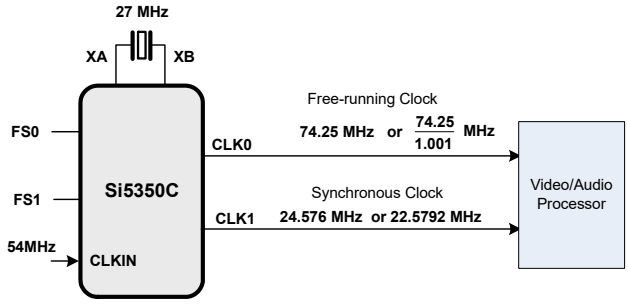


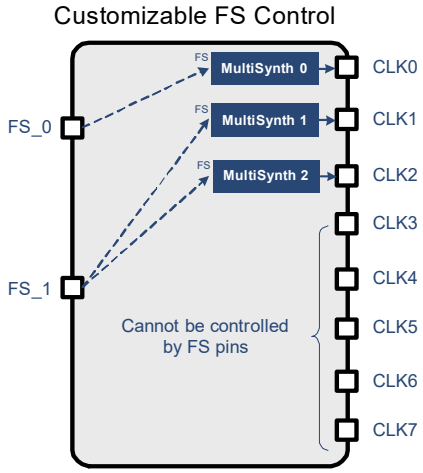
Figure 7. Example of Generating Two Clock Frequencies from the Same Clock Output

Up to two frequency select pins are available on the Si5350C. Each of the frequency select pins can be linked to CLK0, 1, and 2 for 20-QFN and 10-MSOP devices. 16-QFN devices allow frequency select on CLK0 and CLK1. See Figure 8 for an example of a potential 20-QFN frequency select configuration. In this example, FS_0 is linked to control clock frequency selection on CLK0; FS_1 can be used to control clock frequency selection on CLK1 and CLK2. Any other combination is also possible. The frequency select feature is not available for CLK3/4/5/6/7 in 20-QFN devices or for CLK2/3 in 16-QFN devices.

The Si5350C 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.

FS_0	Output Frequency
0	F1_0
1	F2_0

FS_1	Output Frequency
0	F1_1, F1_2
1	F2_1, F2_2



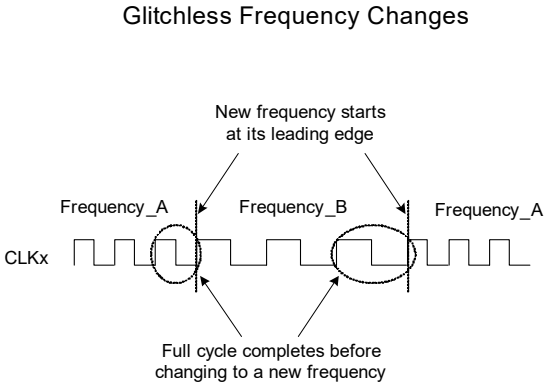


Figure 8. Example Configuration of a Pin-Controlled Frequency Select (FS)

6.4.4. Output Enable (OEB_0, OEB_1, OEB_2)

Up to three output enable pins (OEB_0/1/2) are available on the Si5350C. 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.

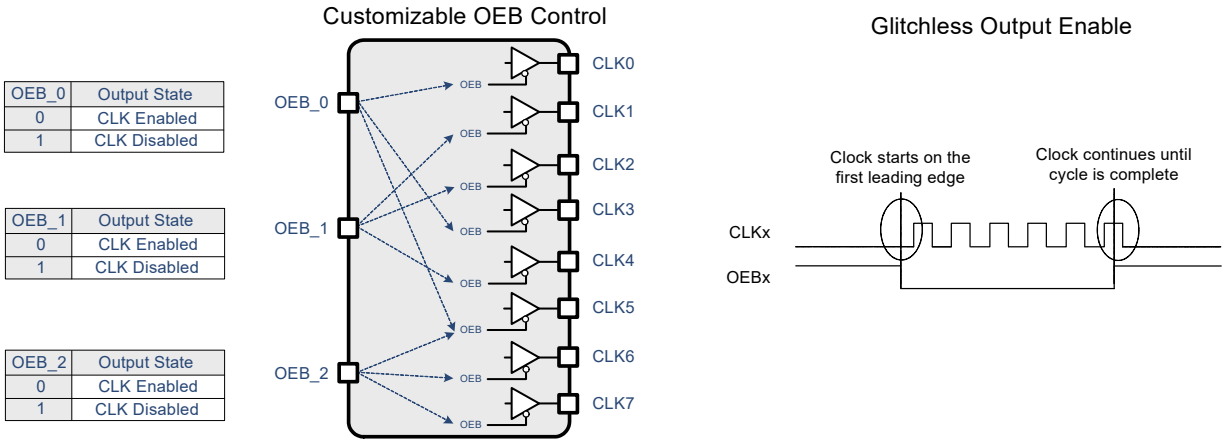


Figure 9. Example Configuration of a Pin-Controlled Output Enable

6.4.5. Loss Of Lock (LOLB)

A loss of lock pin (LOLB) is available to indicate the status of the synchronous clock outputs. The LOLB pin is set to a high state when the synchronous clock outputs are locked to the clock input (CLKIN). This is the normal operating state for the synchronous clocks. The LOLB pin will go low when the reference clock at the CLKIN input is removed or if its frequency deviates by more than 2000 ppm from its defined center frequency. In this case, the synchronous clocks will continue to free-run. An option to disable the synchronous output clocks during an LOLB condition (LOLB pin = low) is available. This only affects the clock outputs that were designated as synchronous clock outputs. An external pull up resistor (recommended 10 kohms) is needed on LOLB as it is an open-drain signal, not a push-pull output.

6.5. Design Considerations

The Si5350C is a self-contained clock generator that requires very few external components. The following general guidelines are recommended to ensure optimum performance.

6.5.1. Power Supply Decoupling/Filtering

The Si5350C 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 µF decoupling capacitor per power supply pin. This capacitor should be mounted as close to the VDD and VDDO pins as possible without using vias.

6.5.2. 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.

6.5.3. 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.

6.5.4. External Crystal Load Capacitors

The Si5350C 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.

6.5.5. Unused Pins

Unused control pins (P0–P3) should be tied to GND.

Unused CLKIN pin should be tied to GND.

Unused XA/XB pins should be left floating. Refer to "4.2. Applying a Reference Clock at XTAL Input" on page 11 when using XA as a clock input pin.

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

Unused VDDOx pins should be tied to VDD.

6.5.6. Trace Characteristics

The Si5350C 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.

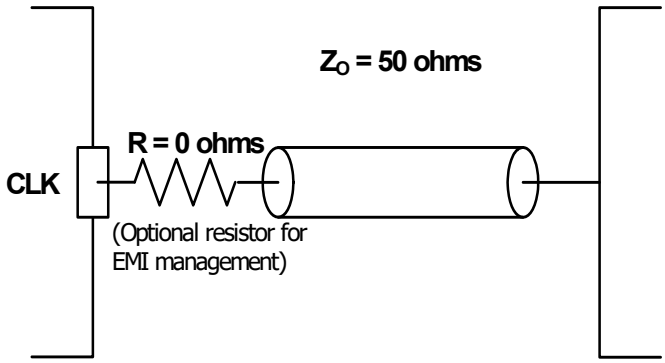


Figure 10. Recommended Trace Characteristics with Default Drive Strength Setting

7. Pin Descriptions

7.1. 20-Pin QFN

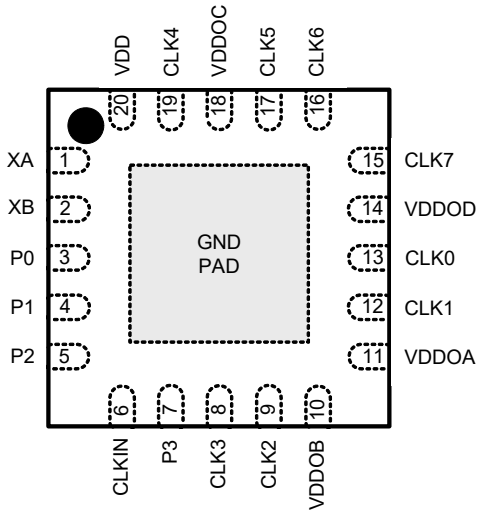


Figure 11. Si5350C 20-QFN Top View

Table 14. Si5350C 20-QFN Pin Descriptions

Pin Name	Pin Number	Pin Type	Function
XA	1	I	Input pin for external XTAL.
XB	2	I	Input pin for external XTAL.
CLKIN	6	I	External reference clock input.
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 pin 0. See Section 6.4.
P1	4	I	User configurable pin 1. See Section 6.4.
P2	5	I	User configurable pin 2. See Section 6.4.
P3	7	I	User configurable pin 3. See Section 6.4.
VDD	20	P	Core voltage supply pin. See Section 6.5.2.
VDDOA	11	P	Output voltage supply pin for CLK0 and CLK1. See Section 6.5.2.
VDDOB	10	P	Output voltage supply pin for CLK2 and CLK3. See Section 6.5.2.
VDDOC	18	P	Output voltage supply pin for CLK4 and CLK5. See Section 6.5.2.
VDDOD	14	P	Output voltage supply pin for CLK6 and CLK7. See Section 6.5.2.
GND	Center Pad	P	Ground.
Note: Pin Types: I = Input, O = Output, P = Power			

7.2. 16-Pin QFN

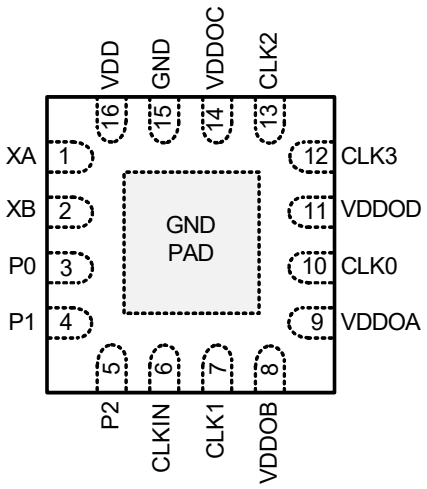


Figure 12. Si5350C 16-Pin QFN Top View

Table 15. Si5350C 16-QFN Pin Descriptions

Pin Name	Pin Number	Pin Type*	Function
XA	1	I	Input pin for external crystal.
XB	2	I	Input pin for external crystal.
P0	3	I	User configurable input P0. See Section 6.4.
P1	4	I	User configurable input P1. See Section 6.4.
P2	5	I	User configurable input P2. See Section 6.4.
CLKIN	6	I	External reference clock input.
CLK1	7	O	Output Clock 1.
VDDOB	8	P	Output voltage supply pin for CLK1. See Section 6.5.2.
VDDOA	9	P	Output voltage supply pin for CLK0. See Section 6.5.2.
CLK0	10	O	Output Clock 0.
VDDOD	11	P	Output voltage supply pin for CLK3. See Section 6.5.2.
CLK3	12	O	Output Clock 3.
CLK2	13	O	Output Clock 2.
VDDOC	14	P	Output voltage supply pin for CLK2. See Section 6.5.2.
GND	15	GND	Ground.
VDD	16	P	Core voltage supply pin. See Section 6.5.2.
GND PAD	Center Pad	GND	Ground pad. Use multiple vias to ensure a solid path to Ground.
***Note:** I = Input, O = Output, P = Power; GND = Ground. Input pins are not internally pulled up.			

7.3. 10-Pin MSOP

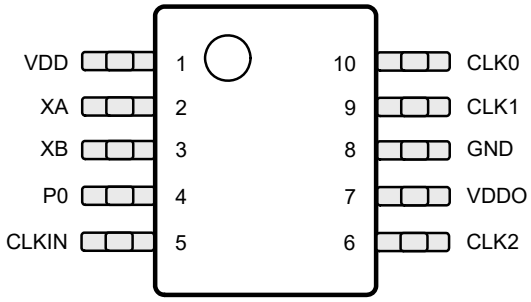


Figure 13. Si5350C 10-MSOP Top View

Table 16. Si5350C 10-MSOP Pin Descriptions

Pin Name	Pin Number	Pin Type	Function
XA	2	I	Input pin for external XTAL.
XB	3	I	Input pin for external XTAL.
CLKIN	5	I	External reference clock input.
CLK0	10	O	Output clock 0.
CLK1	9	O	Output clock 1.
CLK2	6	O	Output clock 2.
P0	4	I	User configurable pin 0. See Section 6.4.
VDD	1	P	Core voltage supply pin. See Section 6.5.2.
VDDO	7	P	Output voltage supply pin for CLK0, CLK1, and CLK2. See Section 6.5.2.
GND	8	P	Ground.
Note: Pin Types: I = Input, O = Output, P = Power			

8. Ordering Information

Factory programmed Si5350B devices can be requested through ClockBuilder Pro. A unique part number is assigned to each custom configuration as indicated in Figure 14. Use ClockBuilder Pro to create custom part numbers or consult a Skyworks Solutions sales representative for other custom NVM configurations.

The Si5351x-B20QFN-EVB evaluation kit, along with ClockBuilder Pro, enables easy testing of any Si5350B frequency plan. ClockBuilder Pro makes it simple to emulate all three Si5350B packages, including the 10-MSOP, 20-QFN, and 16-QFN, on the same evaluation board.

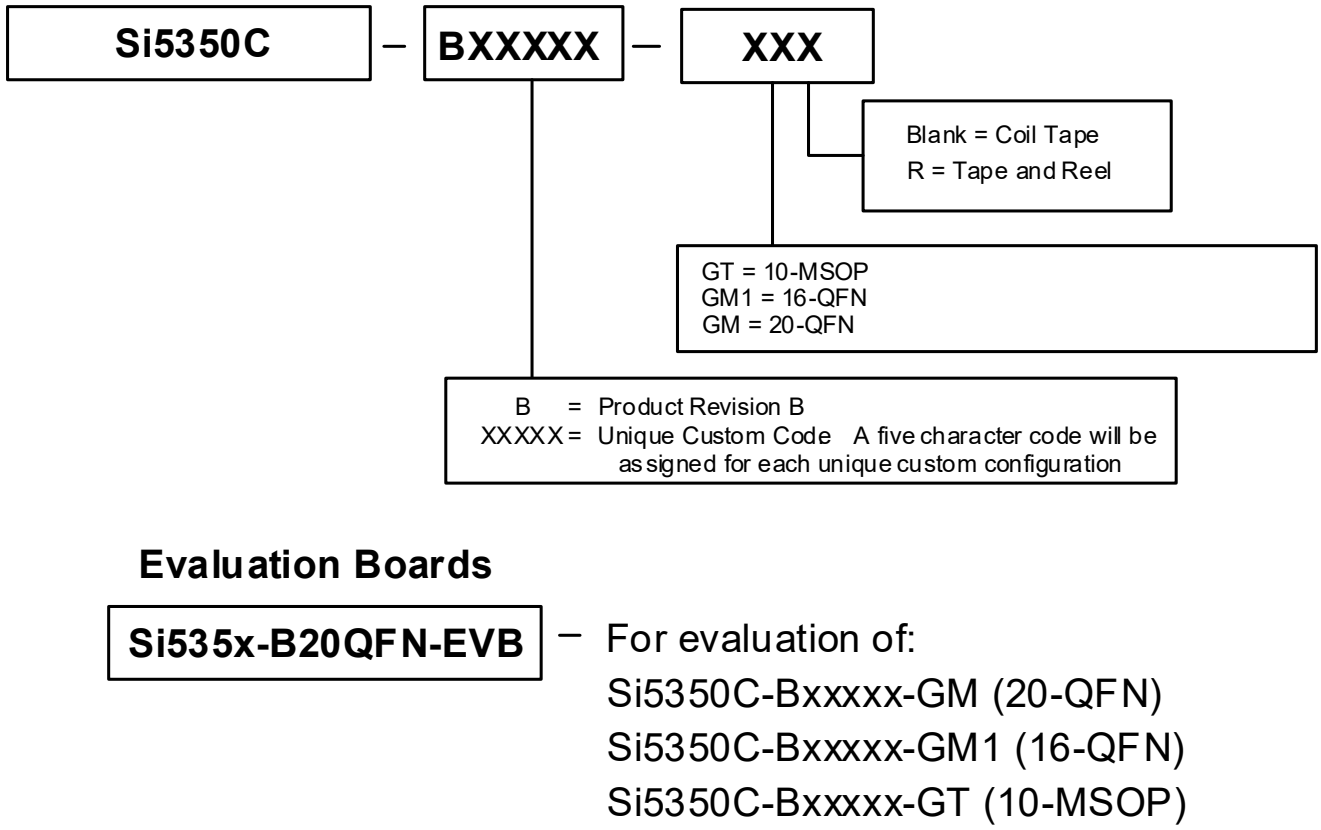


Figure 14. Custom Clock Part Numbers

9. Packaging

9.1. 20-Pin QFN Package Outline

Figure 15 illustrates the package details for the Si5350C-B in a 20-pin QFN package. Table 17 lists the values for the dimensions shown in the illustration.

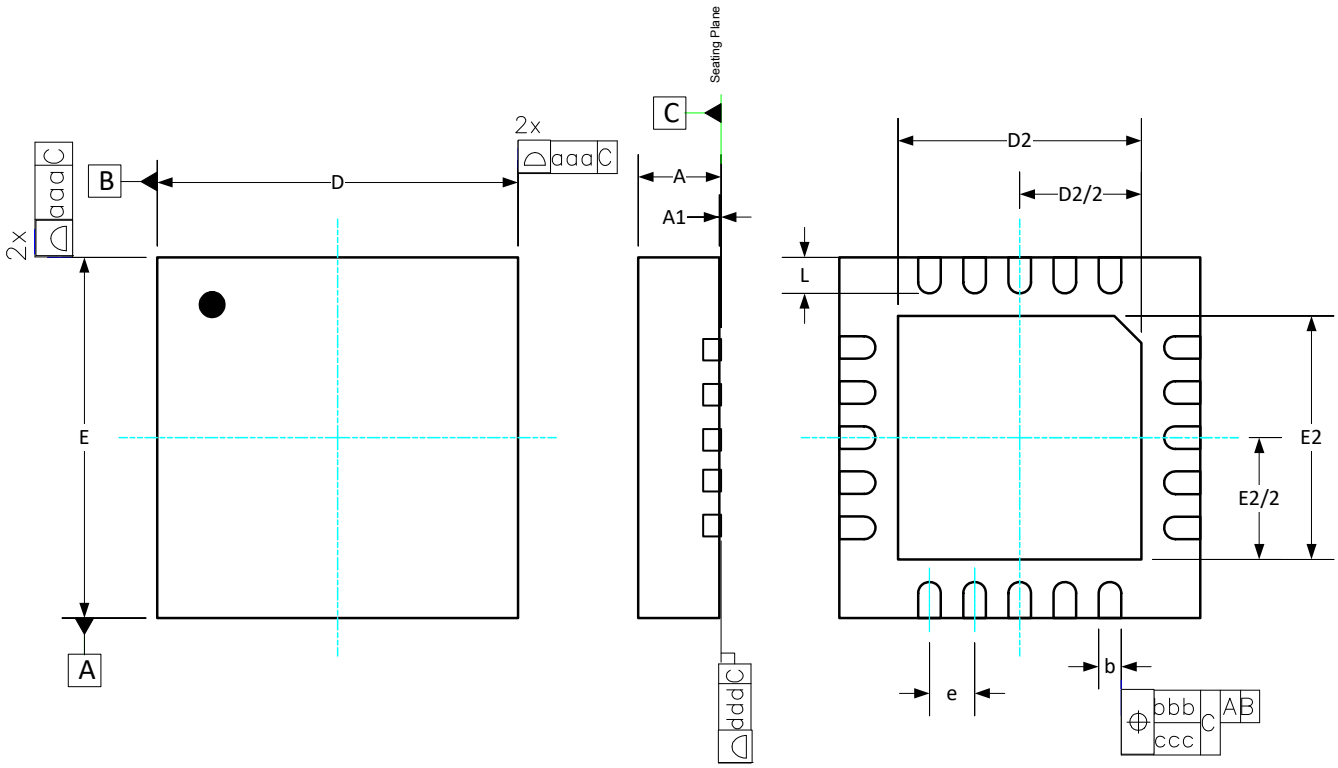


Figure 15. 20-pin QFN Package Drawing

Table 17. Package Dimensions

Dimension	Min	Nom	Max
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

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 VGGD-5.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

9.2. Land Pattern: 20-Pin QFN

Figure 16 shows the recommended land pattern details for the Si5350 in a 20-Pin QFN package. Table 18 lists the values for the dimensions shown in the illustration.

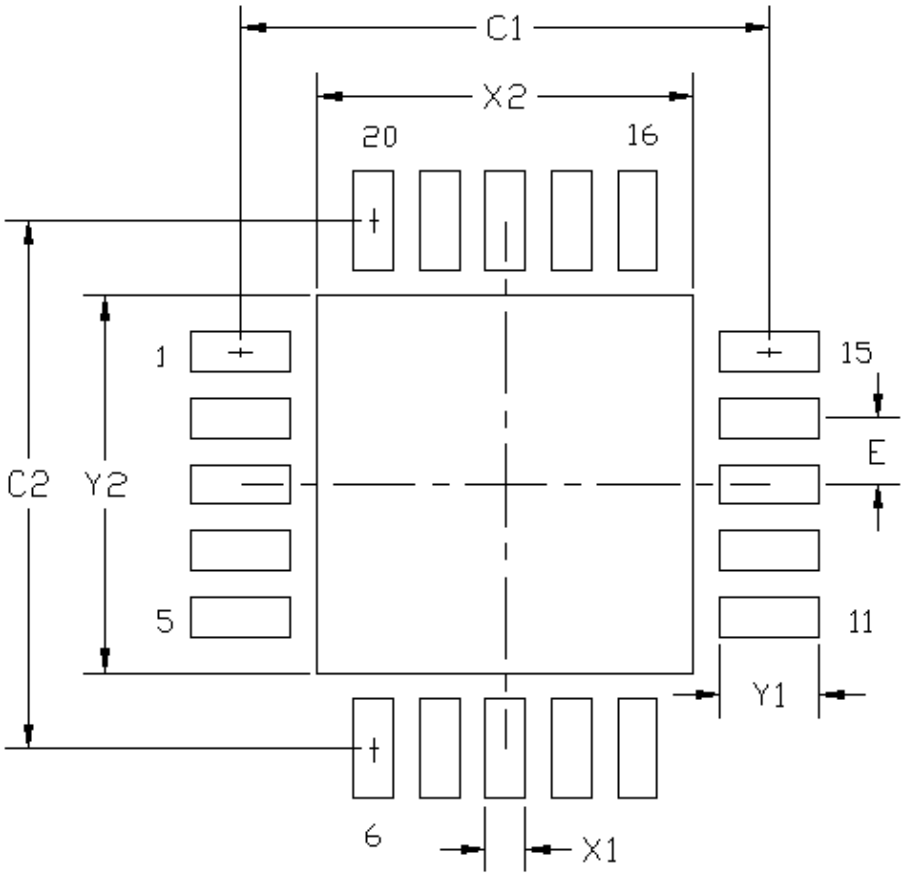


Figure 16. 20-Pin QFN Land Pattern

Table 18. 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 µm 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.

9.3. 16-Pin QFN Package Outline

Figure 17 illustrates the package details for the Si5350C-B in a 16-QFN package. Table 19 lists the values for the dimensions shown in the illustration.

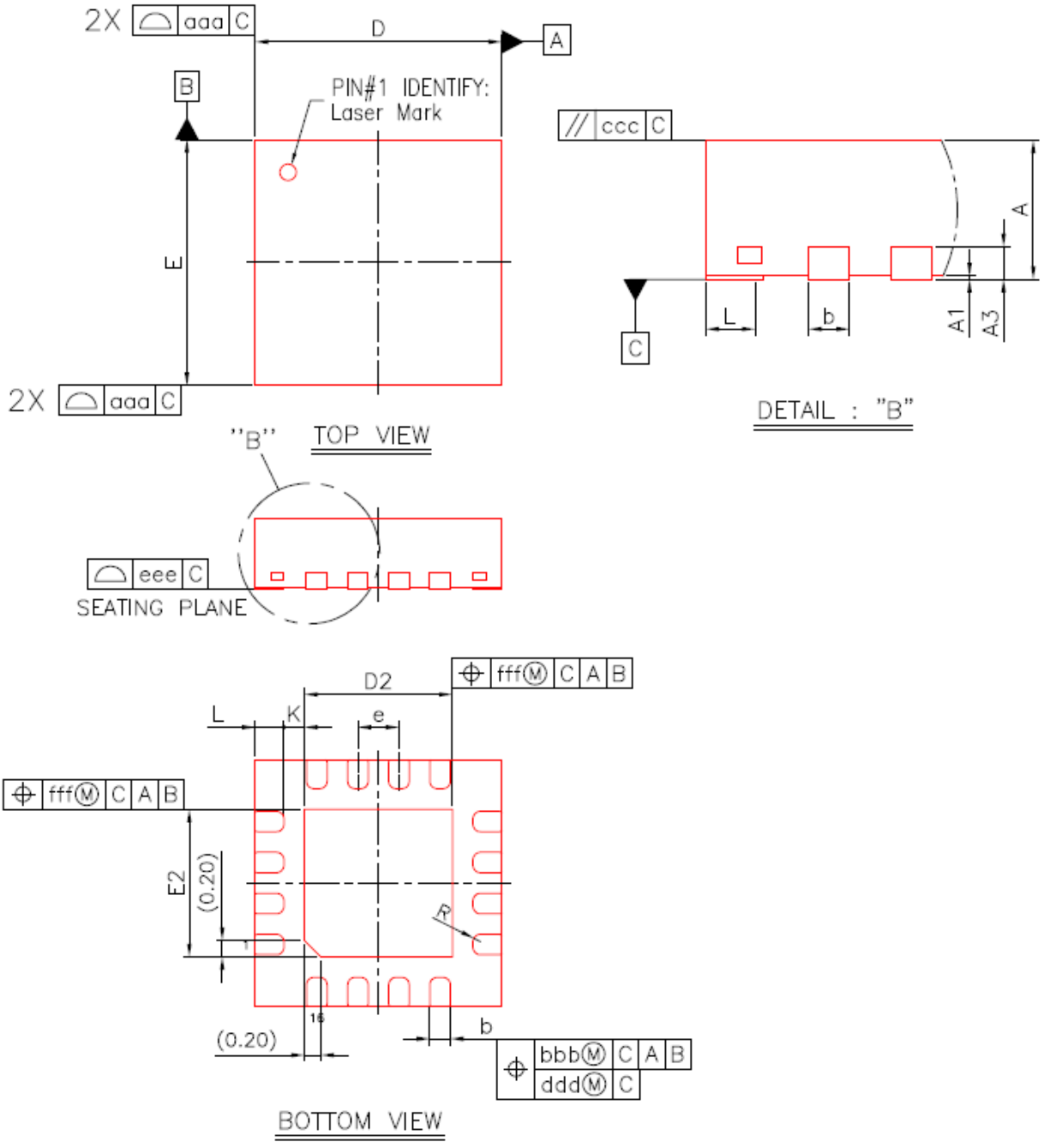


Figure 17. 16-Pin QFN Package Drawing

Table 19. Package Dimensions

Dimension	Min	Nom	Max
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A3		0.20 REF.	
b	0.18	0.25	0.30
D		3.0 BSC	
D2	1.70	1.80	1.90
e		0.50 BSC	
E		3.0 BSC	
E2	1.70	1.80	1.90
L	0.25	0.35	0.45
K	0.20	—	—
R	0.09	—	0.14
aaa		0.15	
bbb		0.10	
ccc		0.10	
ddd		0.05	
eee		0.08	
fff		0.10	

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

9.4. Land Pattern: 16-Pin QFN

Figure 18 shows the recommended land pattern details for the Si5350 in a 16-QFN package. Table 20 lists the values for the dimensions shown in the illustration.

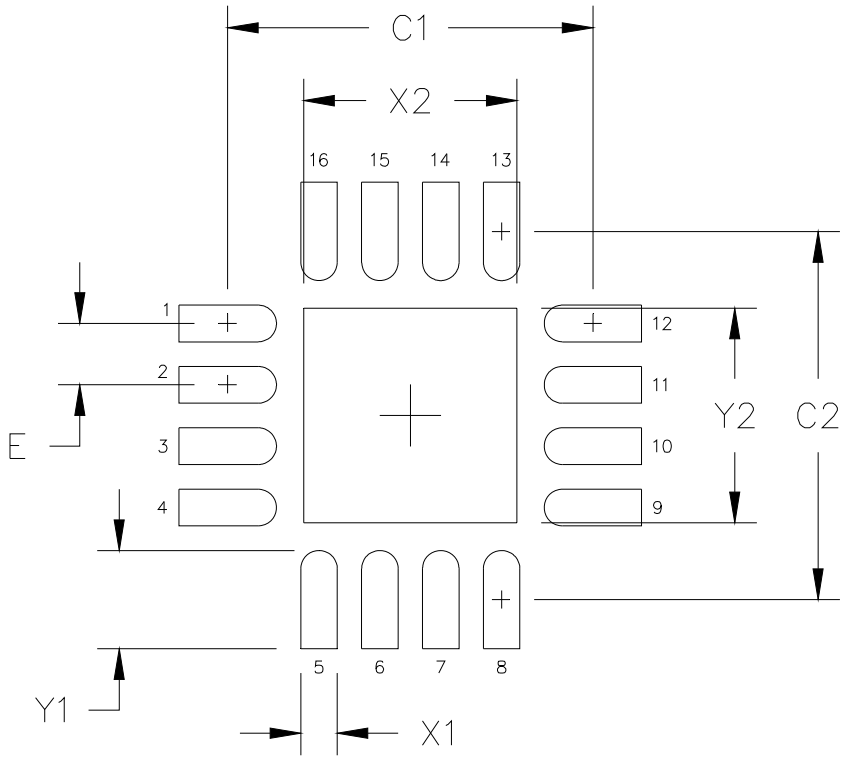


Figure 18. 16-Pin QFN Land Pattern

Table 20. PCB Land Pattern Dimensions

Symbol	Millimeters
C1	3.00
C2	3.00
E	0.50
X1	0.30
Y1	0.75
X2	1.80
Y2	1.80

Notes:

General

1. All dimensions shown are in millimeters (mm).
2. This land pattern design is based on IPC-7351 guidelines.
3. 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

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

Stencil Design

5. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
6. The stencil thickness should be 0.125 mm (5 mils).
7. The ratio of stencil aperture to land pad size should be 1:1 for all perimeter pads.
8. A 2x2 array of 0.65 mm square openings on a 0.90 mm pitch should be used for the center ground pad.

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-020 specification for Small Body components.
11. The above notes and stencil design are shared as recommendations only. A customer or user may find it necessary to use different parameters and fine-tune their SMT process as required for their application and tooling.

9.5. 10-Pin MSOP Package Outline

Figure 19 illustrates the package details for the Si5350C-B in a 10-pin MSOP package. Table 21 lists the values for the dimensions shown in the illustration.

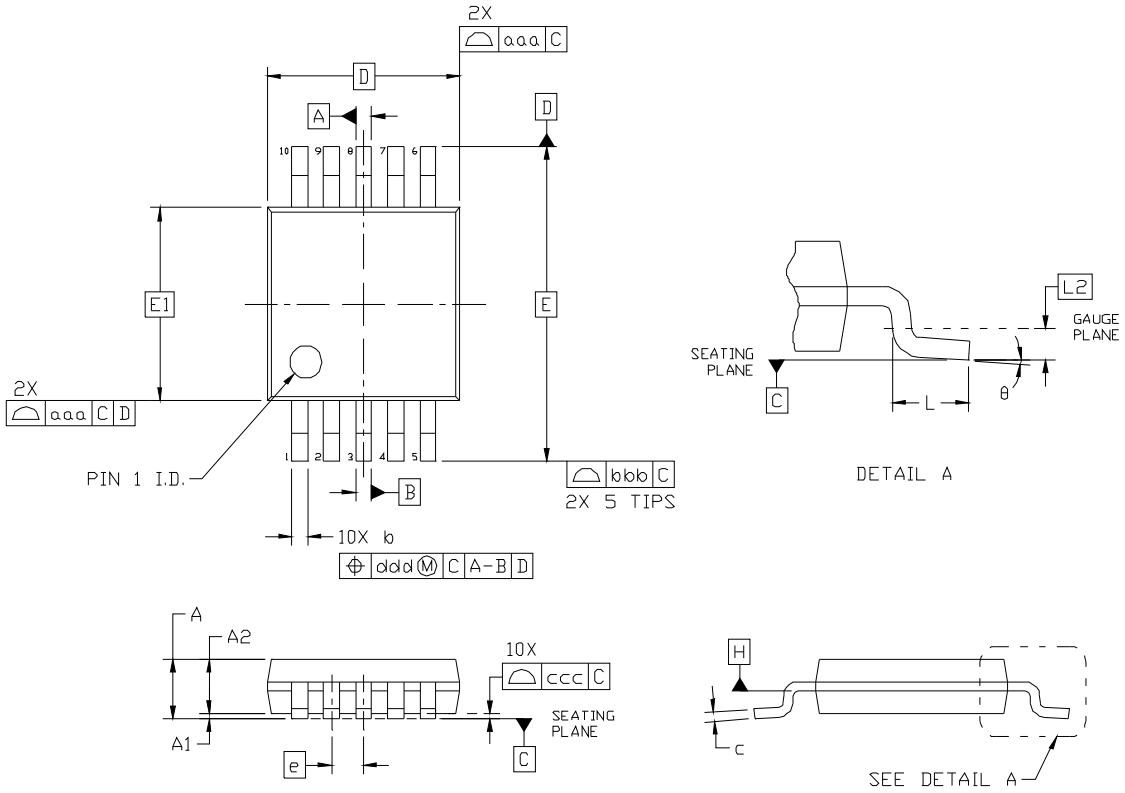


Figure 19. 10-pin MSOP Package Drawing

Table 21. 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

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 the JEDEC Solid State Outline MO-137, Variation C
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

9.6. Land Pattern: 10-Pin MSOP

Figure 20 shows the recommended land pattern details for the Si5350C-B in a 10-Pin MSOP package. Table 22 lists the values for the dimensions shown in the illustration.

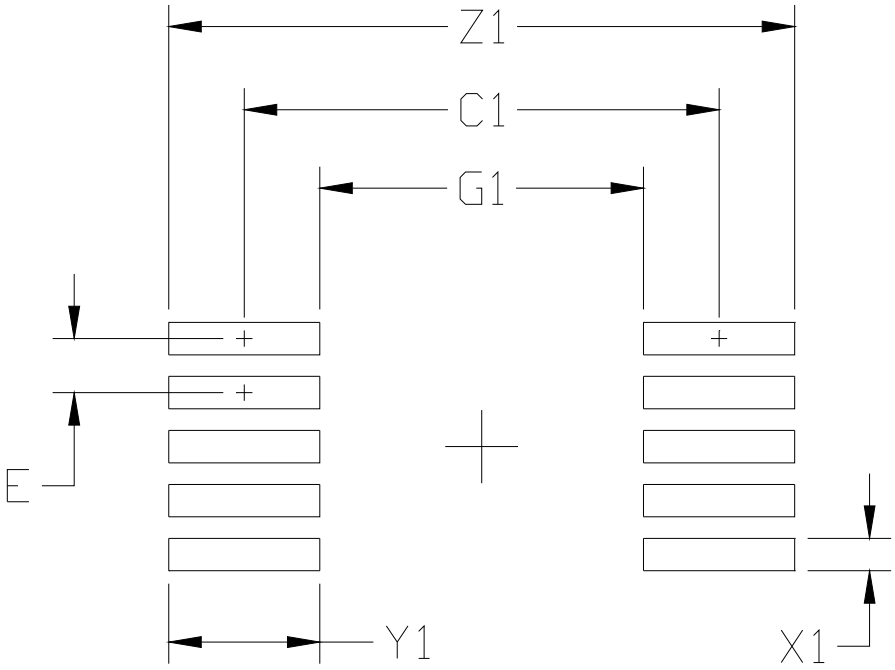


Figure 20. 10-Pin MSOP Land Pattern

Table 22. 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 µm 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.

10. Top Marking

10.1. 20-Pin QFN Top Marking

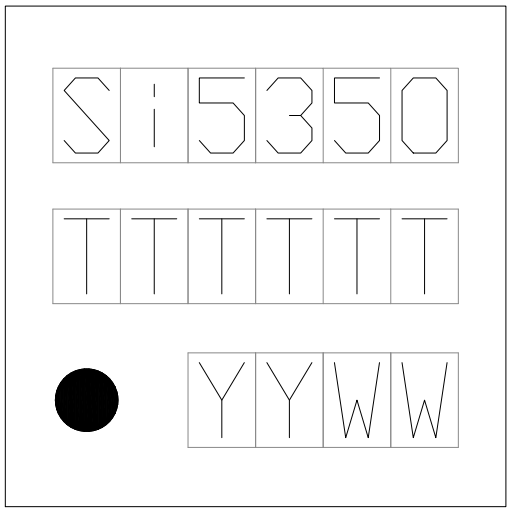


Figure 21. 20-Pin QFN Top Marking

10.2. 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 WW = Work Week	Assigned by the Assembly House. Corresponds to the year and work week of the assembly date.
***Note:** 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.		

10.3. 16-Pin QFN Top Marking

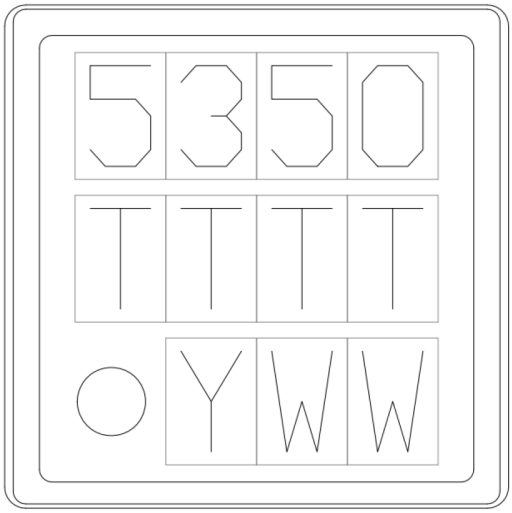


Figure 22. 16-Pin QFN Top Marking

10.4. Top Marking Explanation

Mark Method:	Laser	
Pin 1 Mark:	Circle (Bottom-Left Corner)	
Font Size:	0.60 mm (24 mils)	
Line 1 Mark Format	Device Part Number	5350
Line 2 Mark Format:	TTTT = Mfg Code*	Manufacturing Code from the Assembly Purchase Order Form.
Line 3 Mark Format:	YWW = Date Code	Assigned by the Assembly House. Y = Last digit of the current year. WW = Work week of the assembly date.
***Note:** 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.		

10.5. 10-Pin MSOP Top Marking

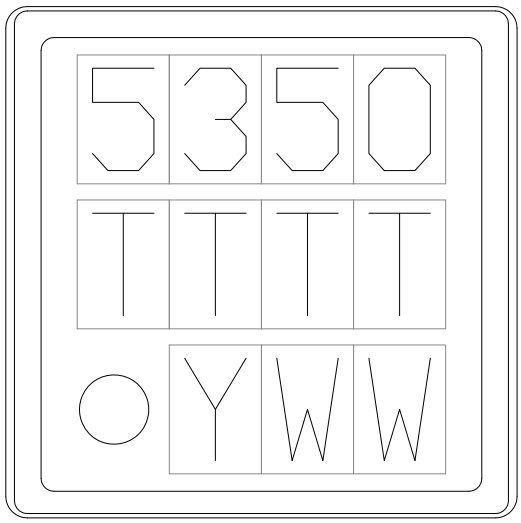


Figure 23. 10-Pin MSOP Top Marking

10.6. Top Marking Explanation

Mark Method:	Laser	
Pin 1 Mark:	Mold Dimple (Bottom-Left Corner)	
Font Size:	0.60 mm (24 mils)	
Line 1 Mark Format	Device Part Number	5350
Line 2 Mark Format:	TTTT = Mfg Code*	Line 2 from the “Markings” section of the Assembly Purchase Order form.
Line 3 Mark Format:	YWW = Date Code	Assigned by the Assembly House. Y = Last Digit of Current Year (Ex: 2013 = 3) WW = Work Week of Assembly Date.
***Note:** 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.		

Revision History

Revision 1.2

March, 2020

- Added "1. Ordering Guide" on page 2.
- Updated "3. Electrical Specifications" on page 5.
  - Updated Tables 5, 7, 12, and 13 to include 16-QFN parameters.
  - Updated thermal characteristics tables to include Table 10 (2-Layer Board), Table 11 (4-Layer Board), and Table 12 (Junction-to-Case).
- Updated "4. Typical Application" on page 11.
  - Updated "4.3. HCSL Compatible Outputs" on page 12.
- Updated "5. Functional Description" on page 13.
- Updated "6. Configuring the Si5350C" on page 14.
  - Updated "6.3. Output Clocks (CLK0–CLK7)" on page 14.
  - Updated "6.4.3. Frequency Select (FS_0, FS_1)" on page 15.
  - Updated "6.5.5. Unused Pins" on page 18.
- Updated "7. Pin Descriptions" on page 19.
  - Added 16-QFN information.
- Updated "8. Ordering Information" on page 22.
  - Updated EVB and 16-QFN information.
- Updated "9. Packaging" on page 23.
  - Added 16-QFN information.

Revision 1.1

August, 2018

- Updated "8. Ordering Information" on page 22.
  - Changed “Blank = Bulk” to “Blank = Coil Tape” in Figure 14.

Revision 1.0

April, 2015

- Extended frequency range from 8 MHz-160 MHz to 2.5 kHz-200 MHz.
- Added 1.8V VDD support.
- Updated block diagrams for clarity.
- Added complete Si5350/51 family table, Table 1.
- Added top mark information.
- Added landing pattern drawings.
- Added PowerUp Time, PLL Bypass, Table 5.
- Clarified Down Spread step sizes in Table 5.
- Updated max jitter specs (typ unchanged) in Table 7.
- Clarified power supply sequencing requirement, Section 6.5.2.
- Updated 4.4.5 Loss of Lock (LOLB) section.

Revision 0.76

October, 2013

- Updated Table 5 on page 6.
  - Updated spread-spectrum frequency deviation parameter test condition and minimum spec value.
- Updated “8. Ordering Information” .
  - Updated Figure 14, “Custom Clock Part Numbers,” on page 22.

Revision 0.75

October, 2012

- Initial release.

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