

HW-CLK-101-SCLK2 SuperClock-2 Module

User Guide

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Revision History

The following table shows the revision history for this document.

Date	Version	Revision
09/23/10	1.0	Initial Xilinx release.

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About This Guide

This document describes the features and operation of the HW-CLK-101-SCLK2 SuperClock-2 module. The SuperClock-2 module is a plug-in board that provides a programmable, low-noise and low-jitter clock source for Xilinx® transceiver characterization boards including:

- ML628 Virtex®-6 FPGA GTX and GTH transceiver characterization board
- ML623 Virtex-6 FPGA GTX transceiver characterization board
- SP623 Spartan®-6 FPGA GTP transceiver characterization board

Additional Resources

To find additional documentation, see the Xilinx website at:

<http://www.xilinx.com/support/documentation/index.htm>.

To search the Answer Database of silicon, software, and IP questions and answers, or to create a technical support WebCase, see the Xilinx website at:

<http://www.xilinx.com/support>.

To find Information about the ISE® Design Suite, see the Xilinx website at:

www.xilinx.com/ise

To find Information about intellectual property, see the Xilinx website at:

www.xilinx.com/ipcenter

Characterization board documentation, schematics and PCB design files are available at

www.xilinx.com/support/documentation/board_and_kit_documentation.htm.

Technical Support

Xilinx offers technical support for the SuperClock-2 module when used in conjunction with the characterization boards listed here:

- ML628 Virtex-6 FPGA GTX and GTH transceiver characterization board
- ML623 Virtex-6 FPGA GTX transceiver characterization board
- SP623 Spartan-6 FPGA GTP transceiver characterization board

For assistance, see the Xilinx website at:

www.xilinx.com/support.

Conventions

This document uses the conventions listed in this section. An example illustrates each convention.

Typographical

These typographical conventions are used in this document:

Convention	Meaning or Use	Example
<i>Italic font</i>	References to other manuals	See the <i>Command Line Tools User Guide</i> for more information.
	Emphasis in text	If a wire is drawn so that it overlaps the pin of a symbol, the two nets are <i>not</i> connected.
Square brackets []	An optional entry or parameter. However, in bus specifications, such as bus [7:0] , they are required.	ngdbuild [option_name] design_name

Online Document

These conventions are used in this document:

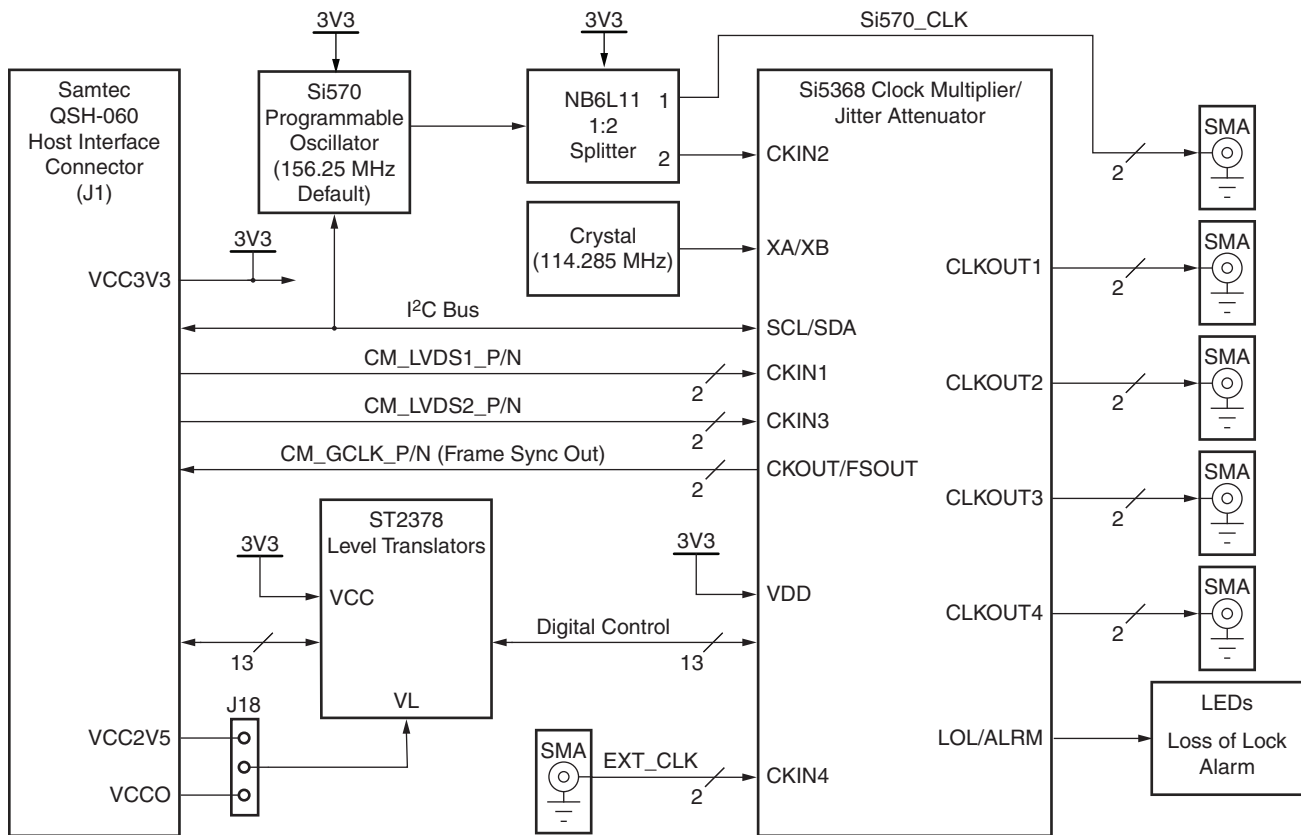
Convention	Meaning or Use	Example
Blue text	Cross-reference link to a location in the current document	See the section “ Additional Resources ” for details. Refer to “ Title Formats ” in Chapter 1 for details.
Blue, underlined text	Hyperlink to a website (URL)	Go to http://www.xilinx.com for the latest speed files.

HW-CLK-101-SCLK2 SuperClock-2 Module

The HW-CLK-101-SCLK2 SuperClock-2 module is a precision clock multiplier with sub-1 ps rms jitter performance for use with Xilinx® transceiver characterization boards including:

- ML628 Virtex®-6 FPGA GTX and GTH transceiver characterization board
- ML623 Virtex-6 FPGA GTX transceiver characterization board
- SP623 Spartan®-6 FPGA GTP transceiver characterization board

The SuperClock-2 module (Figure 1) provides five independent clock outputs and can select any of three input clock sources as the reference for an internal digital clock oscillator (DCO). The output clocks can be programmed for any frequency in the range from 2 kHz to 808 MHz. The SuperClock-2 module has no onboard voltage regulators. Power (3.3VDC) is provided through the host interface connector J1.



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Figure 1: SuperClock-2 Module Block Diagram

SuperClock-2 Module Features

- Compatible with Virtex-6 GTX and GTH characterization boards
- Compatible with Spartan-6 GTP characterization boards
- LEDs indicate loss of lock and programmable alarm conditions
- Programmable crystal oscillator (Silicon Laboratories Si570):
 - I²C serial interface
 - Programmable to any output frequency from 10 MHz to 810 MHz
 - 156.25 MHz default frequency
 - One LVDS output clock to SMA pair
 - Jitter performance: less than 1 ps RMS
- Any-rate precision clock multiplier/jitter attenuator (Silicon Laboratories Si5368):
 - I²C serial interface
 - Programmable to any output frequency from 2 kHz to 808 MHz
 - One LVDS input clock from SMA pair
 - Two LVDS input clocks via host interface connector
 - Four LVDS output clocks to SMA pairs
 - One LVDS output clock to host interface connector
 - Jitter performance: Less than 1 ps RMS

I²C Interface

The Si570 Programmable crystal oscillator and the Si5368 clock generator/jitter attenuator are slave devices sharing the same I²C bus. Pull-up resistors for the serial data a clock lines are located on the host characterization board only. Both devices support fast mode up to 400 kbps. The I²C idcodes for each device are listed in [Table 1](#).

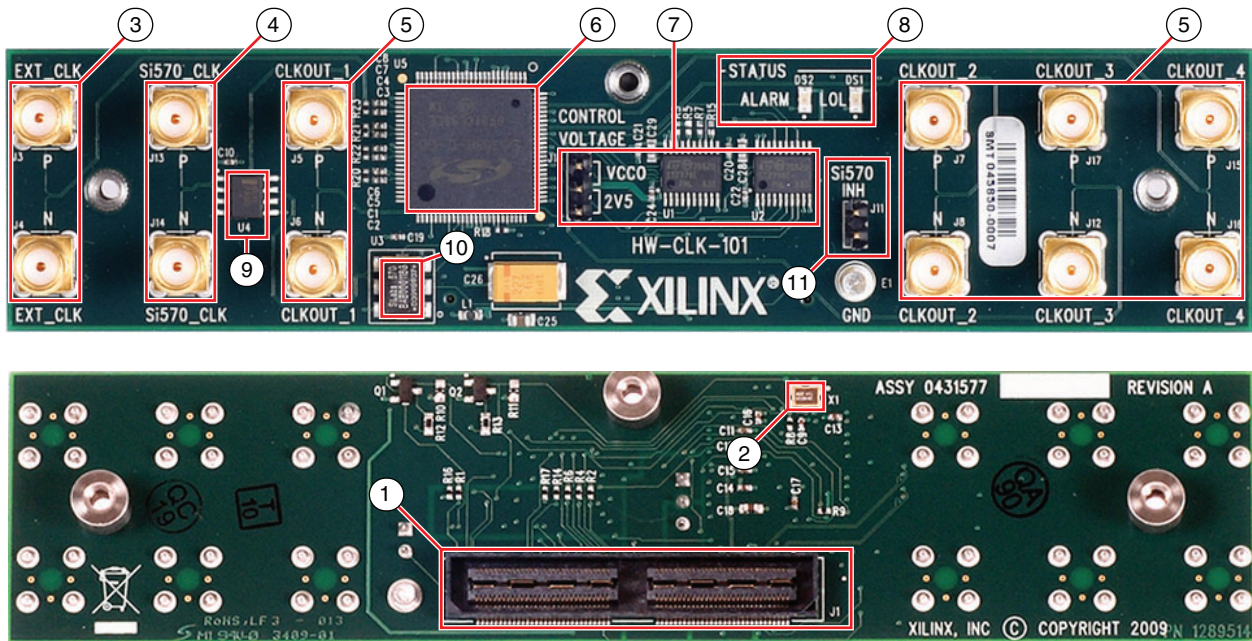
Table 1: I²C Device idcodes

Device	I ² C idcode (Hex)	I ² C idcode (Decimal)
Si570	0x55	85
Si5368	0x68	104

Detailed Description

[Figure 2](#) shows the SuperClock-2 module. Each numbered feature that is referenced in the figure is described in the sections that follow.

Note: The image in [Figure 2](#) is for reference and might not reflect the current revision of the module.



- 1 SAMTEC 120-pin QSH host interface connector (J1): J1 provides power from host board, digital control signals and LVDS clocks.
- 2 114.285 MHz Crystal (X1): X1 is the fixed frequency reference for the Si5368 programmable crystal oscillator.
- 3 External clock SMA pair (J3/J4): J3 and J4 are connectors for an LVDS input clock. These signals are AC coupled and routed to the Si5368 clock multiplier/jitter attenuator.
- 4 Si570 programmable crystal oscillator clock out SMA pair (J13/J14): This output is a buffered copy of the Si570 programmable oscillator.
- 5 Si5368 clock output SMA pairs (J5/J6, J7/J8, J17/J12, J15/J18): CLK_OUT1 through CLK_OUT4 provide four LVDS clock output pairs from the Si5368 any-rate precision clock multiplier/jitter attenuator.
- 6 Si5368 any-rate precision clock multiplier/jitter attenuator (U5): Provides the clock for CLK_OUT1 through CLK_OUT4.
- 7 ST2378 level translators (U1, U2) and host voltage source selection header (J18): U1 and U2 convert the variable I/O control voltage from the host board to the 3.3V logic levels used by the SuperClock-2 module. The position of the jumper on J18 selects translation from either 2.5V or VCCO logic levels.
- 8 Status LEDs (DS1 and DS2): When illuminated, DS1 indicates loss of lock and DS2 indicates a programmable ALARM condition is active.
- 9 NB6L11 1:2 differential clock buffer/splitter (U4): U4 splits and buffers the Si570 clock output for the Si5368 CKIN2 input and the Si570_CLK SMA pair.
- 10 Si570 programmable crystal oscillator (U3): U3 is one of the clock sources for the Si5368.
- 11 Si570 programmable crystal oscillator clock output enable selection header (J11): Installing a jumper at J11 disables the oscillator.

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Figure 2: SuperClock-2 Module Features

Host Interface Connector

[Figure 2, callout 1]

The SuperClock-2 module mates with the host transceiver board using a low profile, 120-pin, high-speed SAMTEC QTS connector. The connector has interior ground blades that are listed as pin 121 through pin 128 in Table 2. For flexibility, the host transceiver board provides three voltage rails on the connector: 2.5 VDC, 3.3 VDC and 5.0VDC.

Table 2: J1 Connector Signal Details

Connector Pin	Host Signal Name	Direction	I/O Standard	Net Name, SuperClock-2 Module	Destination, SuperClock-2 Module
1	CM_LVDS1_P	IN	LVDS	LVDS1_P ⁽¹⁾	U5.44
2	VCC3V3	–	PWR	VCC3V3	–
3	CM_LVDS1_N	IN	LVDS	LVDS1_N ⁽¹⁾	U5.45
4	VCC3V3	–	PWR	VCC3V3	–
5	GND	–	PWR	GND	–
6	VCC3V3	–	PWR	VCC3V3	–
7	GND	–	PWR	GND	–
8	VCC3V3	–	PWR	VCC3V3	–
9	CM_LVDS2_P	IN	LVDS	LVDS2_P ⁽¹⁾	U5.39
10	NC	–	–	NC	–
11	CM_LVDS2_N	IN	LVDS	LVDS2_N ⁽¹⁾	U5.40
12	NC	–	–	NC	–
13	GND	–	PWR	GND	–
14	NC	–	–	NC	–
15	GND	–	PWR	GND	–
16	NC	–	–	NC	–
17	CM_LVDS3_P ⁽²⁾	IN	LVDS	NC	–
18	VCC2V5	–	PWR	VCC2V5	–
19	CM_LVDS3_N ⁽²⁾	IN	LVDS	NC	–
20	VCC2V5	–	PWR	VCC2V5	–
21	GND	–	PWR	GND	–
22	VCC2V5	–	PWR	VCC2V5	–
23	GND	–	PWR	GND	–
24	VCC2V5	–	PWR	VCC2V5	–
25	CM_GCLK_P	OUT	LVDS	GCLK_P	U5.88
26	NC	–	–	NC	–

Table 2: J1 Connector Signal Details (Cont'd)

Connector Pin	Host Signal Name	Direction	I/O Standard	Net Name, SuperClock-2 Module	Destination, SuperClock-2 Module
27	CM_GCLK_N	OUT	LVDS	GCLK_N	U5.87
28	NC	-	-	NC	-
29	GND	-	PWR	GND	-
30	NC	-	-	NC	-
31	GND	-	PWR	GND	-
32	NC	-	-	NC	-
33	NC	-	-	NC	-
34	VCC5	-	PWR	NC	-
35	NC	-	-	NC	-
36	VCC5	-	PWR	NC	-
37	NC	-	-	NC	-
38	VCC5	-	PWR	NC	-
39	NC	-	-	NC	-
40	VCC5	-	PWR	NC	-
41	NC	-	-	NC	-
42	NC	-	-	NC	-
43	NC	-	-	NC	-
44	NC	-	-	NC	-
45	NC	-	-	NC	-
46	NC	-	-	NC	-
47	NC	-	-	NC	-
48	NC	-	-	NC	-
49	NC	-	-	NC	-
50	NC	-	-	NC	-
51	NC	-	-	NC	-
52	NC	-	-	NC	-
53	NC	-	-	NC	-
54	NC	-	-	NC	-
55	NC	-	-	NC	-
56	NC	-	-	NC	-
57	NC	-	-	NC	-
58	NC	-	-	NC	-

Table 2: J1 Connector Signal Details (Cont'd)

Connector Pin	Host Signal Name	Direction	I/O Standard	Net Name, SuperClock-2 Module	Destination, SuperClock-2 Module
59	NC	–	–	NC	–
60	NC	–	–	NC	–
61	CM_CTRL_0	–	LVC MOS	NC	–
62	CM_I2C_SCL	IN	LVC MOS	I2C_SCL	U3.8 / U5.60
63	CM_CTRL_1	–	LVC MOS	NC	–
64	CM_I2C_SDA	BI	LVC MOS	I2C_SDA	U3.7 / U5.61
65	CM_CTRL_2	–	LVC MOS	NC	–
66	CM_RST	IN	LVC MOS	H_RESET_B	U1.2
67	CM_CTRL_3	IN	LVC MOS	H_DEC	U1.16
68	NC	–	–	NC	–
69	CM_CTRL_4	IN	LVC MOS	H_INC	U1.6
70	NC	–	–	NC	–
71	CM_CTRL_5	IN	LVC MOS	H_FS_ALIGN	U2.12
72	NC	–	–	NC	–
73	CM_CTRL_6	–	LVC MOS	NC	–
74	NC	–	–	NC	–
75	CM_CTRL_7	–	LVC MOS	NC	–
76	NC	–	–	NC	–
77	CM_CTRL_8	–	LVC MOS	NC	–
78	NC	–	–	NC	–
79	CM_CTRL_9	OUT	LVC MOS	H_LOL	U2.2
80	NC	–	–	NC	–
81	CM_CTRL_10	OUT	LVC MOS	H_INT_ALARM	U2.18
82	NC	–	–	NC	–
83	CM_CTRL_11	OUT	LVC MOS	H_C1B	U2.4
84	NC	–	–	NC	–
85	CM_CTRL_12	OUT	LVC MOS	H_C2B	U2.16
86	NC	–	–	NC	–
87	CM_CTRL_13	OUT	LVC MOS	H_C3B	U2.6
88	NC	–	–	NC	–
89	CM_CTRL_14	OUT	LVC MOS	H_C1A	U2.14
90	NC	–	–	NC	–

Table 2: J1 Connector Signal Details (Cont'd)

Connector Pin	Host Signal Name	Direction	I/O Standard	Net Name, SuperClock-2 Module	Destination, SuperClock-2 Module
91	CM_CTRL_15	OUT	LVC MOS	H_C2A	U2.8
92	NC	–	–	NC	–
93	CM_CTRL_16	–	LVC MOS	NC	–
94	NC	–	–	NC	–
95	CM_CTRL_17	BI	LVC MOS	H_CS0_C3A	U1.8
96	NC	–	–	NC	–
97	CM_CTRL_18	BI	LVC MOS	H_CS1_C4A	U1.12
98	NC	–	–	NC	–
99	CM_CTRL_19	–	LVC MOS	NC	–
100	NC	–	–	NC	–
101	CM_CTRL_20	–	LVC MOS	NC	–
102	NC	–	–	NC	–
103	CM_CTRL_21	–	LVC MOS	NC	–
104	NC	–	–	NC	–
105	CM_CTRL_22	–	LVC MOS	NC	–
106	NC	–	–	NC	–
107	CM_CTRL_23	–	LVC MOS	NC	–
108	NC	–	–	NC	–
109	NC	–	–	NC	–
110	NC	–	–	NC	–
111	NC	–	–	NC	–
112	NC	–	–	NC	–
113	NC	–	–	NC	–
114	NC	–	–	NC	–
115	NC	–	–	NC	–
116	NC	–	–	NC	–
117	NC	–	–	NC	–
118	NC	–	–	NC	–
119	NC	–	–	NC	–
120	NC	–	–	NC	–
121	GND ⁽³⁾	–	PWR	GND	–
122	GND ⁽³⁾	–	PWR	GND	–

Table 2: J1 Connector Signal Details (Cont'd)

Connector Pin	Host Signal Name	Direction	I/O Standard	Net Name, SuperClock-2 Module	Destination, SuperClock-2 Module
123	GND ⁽³⁾	–	PWR	GND	–
124	GND ⁽³⁾	–	PWR	GND	–
125	GND ⁽³⁾	–	PWR	GND	–
126	GND ⁽³⁾	–	PWR	GND	–
127	GND ⁽³⁾	–	PWR	GND	–
128	GND ⁽³⁾	–	PWR	GND	–

Notes:

1. Signal is AC coupled with 100Ω termination.
2. Optional pin. Not used by the SuperClock-2 module.
3. Pin is an interior blade.

114.285 MHz Crystal

[Figure 2, callout 2]

The Si5368 clock requires an external 114.285 MHz crystal for proper operation of the Si5368 clock multiplier. This source is selected as the primary input for CKIN2.

External Input Clock SMA Pair

[Figure 2, callout 3]

J3 (EXT_CLK_P) and J4 (EXT_CLK_N) can be used to connect to an external differential function generator to CKIN4 of the Si5368 clock multiplier/jitter attenuator. This provides a simple method to establish a reference clock for test purposes.

Si570 Clock Out SMA Pair

[Figure 2, callout 4]

J13 (SI570_CLK_P) and J14 (SI570_CLK_N) are a dedicated SMA clock output pair that connects through the NB6L11 differential buffer (U4) to the Si570 programmable crystal oscillator and bypasses the Si5368 clock multiplier/jitter attenuator.

Si5368 Clock Out SMA Pairs

[Figure 2, callout 5]

Four SMA connector pairs (CLKOUT[4:1]_P/N) are available for connection to any characterization board reference clock. Table 3 lists the signal routing between each SMA connector and the pin on the Si5368 clock multiplier/jitter attenuator (U5).

Table 3: SMA Clock Out Connector Signal Routing

SMA Connector	SuperClock-2 Module Net Name	Si5368 Connection
J5	CKOUT1_P	U5.83
J6	CKOUT1_N	U5.82
J7	CKOUT2_P	U5.92
J8	CKOUT2_N	U5.93
J17	CKOUT3_P	U5.77
J12	CKOUT3_N	U5.78
J15	CKOUT4_P	U5.98
J16	CKOUT4_N	U5.97

Si5368 Jitter Attenuator and Clock Multiplier

[Figure 2, callout 6]

Table 4 lists the four Si5368 input clock channels and shows where each channel is mapped to different resources. All clock inputs are AC coupled with 100Ω differential termination.

Table 4: Si5368 Input Clock Assignments

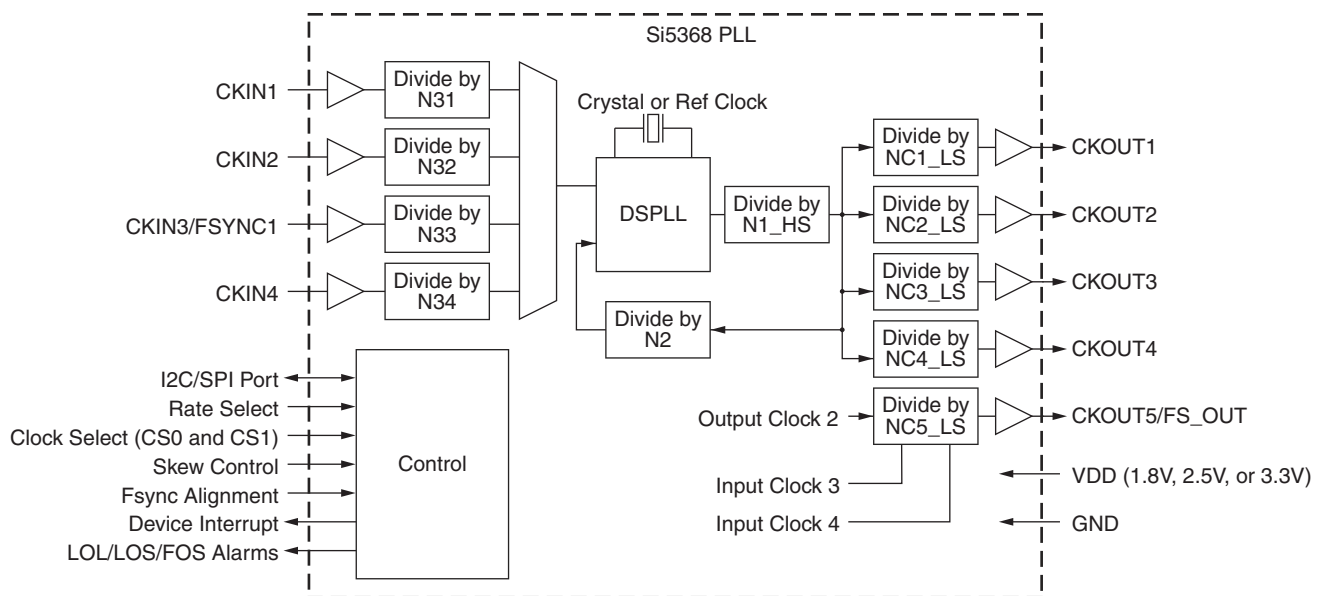
Logical Si5368 Input Clock Channel	Clock Source Connection	Notes
CKIN1	LVDS1	CM_LVDS1 is a differential pair routed through connector J1 to the FPGA on the transceiver characterization board.
CKIN2	Si570 or 114.285 MHz	The Si570 is embedded in the SuperClock-2 module and can be programmed via the I ² C bus to any frequency in the range from 10 MHz to 810 MHz.
CKIN3	LVDS2	CM_LVDS2 is a differential pair routed through connector J1 to the FPGA on the transceiver characterization board.
CKIN4	EXT_CLK	EXT_CLK is an SMA connector pair intended for use with an external LVDS clock source.

The signal routing for the Si5368 input clocks are listed in Table 5.

Table 5: Si5368 Input Clock Routing

Input Clock Source	SuperClock-2 Module Net Name	Si5368 Connection
J1.1	LVDS1_P	U5.44
J1.3	LVDS1_N	U5.45
U4.3	570_B_P	U5.34
U4.4	570_B_N	U5.35
J1.9	LVDS2_P	U5.39
J1.11	LVDS2_N	U5.40
J3	EXT_CLK_P	U5.29
J4	EXT_CLK_N	U5.30

One of the four input clocks can be selected as the “active” clock that is routed to the internal PLL (Figure 3) for frequency synthesis and jitter attenuation. The output of the PLL is presented in parallel to independent dividers associated with output clocks CKOUT1-CKOUT5. Five different frequencies can be generated simultaneously from a single input clock.



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Figure 3: Si5368 PLL Block Diagram

`CM_CTRL_17` and `CM_CTRL_18` are level shifted through U1 and connected to multi-function Si5368 pins CS0_C3A and CS1_C4A respectively. When used as inputs, the pins function as CS0 and CS1. When used as outputs, the pins function as C3A and C4A.

Note: Net names having the `CM_` prefix are the net names used by the host board schematics and documentation.

CS[1:0] are manual clock selection pins decoded as shown in Table 6. By default, manual clock selection mode is enabled. If the transceiver board puts CM_CNTRL_17 and CM_CNTRL_18 in a high-impedance state, or does not issue I²C bus commands that override their default function, the input clock from SMA pair J3/J4 selection is directed to CKIN4.

Table 6: Si5368 Active Input Clock Selection

CS[1:0]	Active Input Clock
00	CKIN1
01	CKIN2
10	CKIN3
11	CKIN4

ST2378 Level Translators

[Figure 2, callout 7]

Level translators U1 and U2 convert host board control signals that might be operating at lower voltages than the 3.3V_{DC} required by the SuperClock-2 module. Selection header J18 (Figure 4) on the SuperClock-2 module must be set for compatibility with the host board control signals.

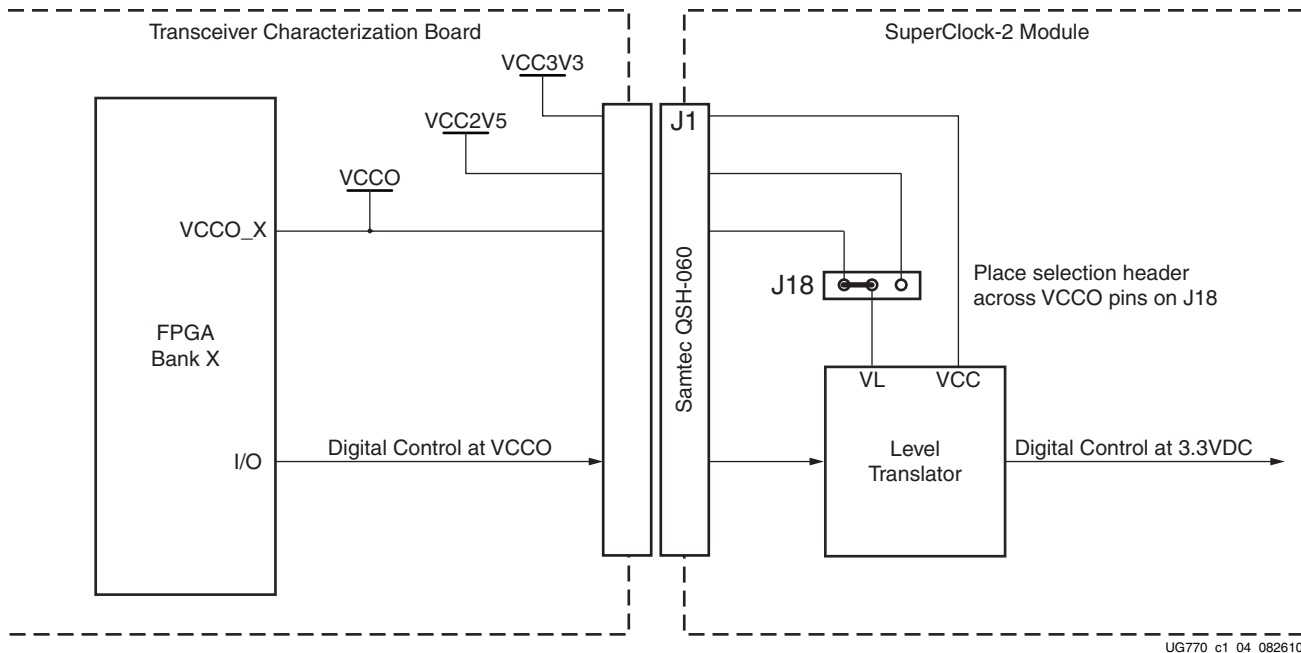


Figure 4: Level Translator Voltage Selection

Setting J18 to the “VCCO” position allows the level translator to track the bank voltage of the FPGA digital controls. The allowable FPGA bank voltage range is $1.8\text{VDC} \leq \text{VCCO} \leq 3.3\text{VDC}$.

Status LEDs

[Figure 2, callout 8]

Alarm conditions annunciated with the LEDs DS1 and DS2 can be read back to the host FPGA using the I²C bus.

Loss of Lock

The Loss of Lock LED (LOL) indicates the state of the Si5368 PLL lock algorithm. The algorithm works by continuously monitoring the phase of the input clock in relation to the phase of the feedback clock. When switching between two input clocks, LOL may be temporarily asserted if the two clocks differ in frequency by more than 100 ppm.

The LED is ON when the Si5368 LOL pin is either in the high impedance state (power-up default) or active high. It is OFF when the PLL is locked.

Alarm

The Alarm LED (ALARM) is a programmable status indicator. It can reflect a variety of internal Si5368 alarm conditions, including loss of signal (LOS), frequency offset (FOS) and frame sync alignment (ALIGN_INT).

Refer to the Si5368 Any Rate Precision Clock Family Reference Manual for a description of the ALARM equation.

NB6L11 Differential Buffer

[Figure 2, callout 9]

The NB6L11 1:2 differential clock buffer (U4) replicates the Si570 programmable oscillator output for two destinations: Output 1 is routed to the [Si570 Clock Out SMA Pair](#) and output 2 is AC coupled and routed to Si5368 CKIN2.

Si570 Programmable Oscillator

[Figure 2, callout 10]

The Silicon Labs Si570 serial I²C bus programmable clock source (U3) provides a low-jitter clock with output frequency range from 10 MHz to 810 MHz. The Si570 clock output is connected to the NB6L11 differential 1:2 buffer. One clock output is AC coupled and routed to CKIN3 on the Si5368. The second clock output is routed to a pair of SMA connectors. [Table 7](#) lists the characteristics of the Si570 Programmable Oscillator.

Table 7: Characteristics of Si570 Component

Parameter	Specification
Output format	LVDS
Output enable polarity	High
Temperature stability	50 ppm
Frequency range	10 MHz–810 MHz
Startup frequency	156.250 MHz
Power supply	3.3V

Oscillator Inhibit

[Figure 2, callout 11]

Header J11 connects to the OE pin of the Si570 programmable oscillator. An internal pull-up resistor normally enables the oscillator. Installing a jumper at J11 grounds the OE pin and disables the output.

Installing the SuperClock-2 Module

Table 8 identifies the SuperClock-2 module interface connector on each of the characterization boards using the module. The connector provides a 120-pin, high-speed interface.

Table 8: Characterization Board SuperClock-2 Module

Characterization Board	Part Number	Interface Connector
ML628 Virtex-6 FPGA GTX and GTH transceiver characterization board	HW-V6-ML628	J32
ML623 Virtex-6 FPGA GTX transceiver characterization board	HW-S6T-SP623	J32
Spartan-6 SP623 MGT GTX transceiver characterization board	HW-V6-ML623	J32

To install the SuperClock-2 module:

1. Align the three metal standoffs on the bottom side of the SuperClock-2 module with the three mounting holes in the clock module interface of the characterization board.
2. Use three 4-40 x 0.25 inch screws to fasten the module to the characterization board.

References

Silicon Laboratories Si570 Data Sheet, <http://www.silabs.com/>

Silicon Laboratories Si5368 Data Sheet, <http://www.silabs.com/>

Silicon Laboratories Any-Rate Precision Clocks Family Reference Manual, <http://www.silabs.com/>

The I²C Bus Specification, Version 2.1, January, 2000, <http://www.nxp.com>

