



## ORCA® ORSPI4 Evaluation Board

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**User's Guide**

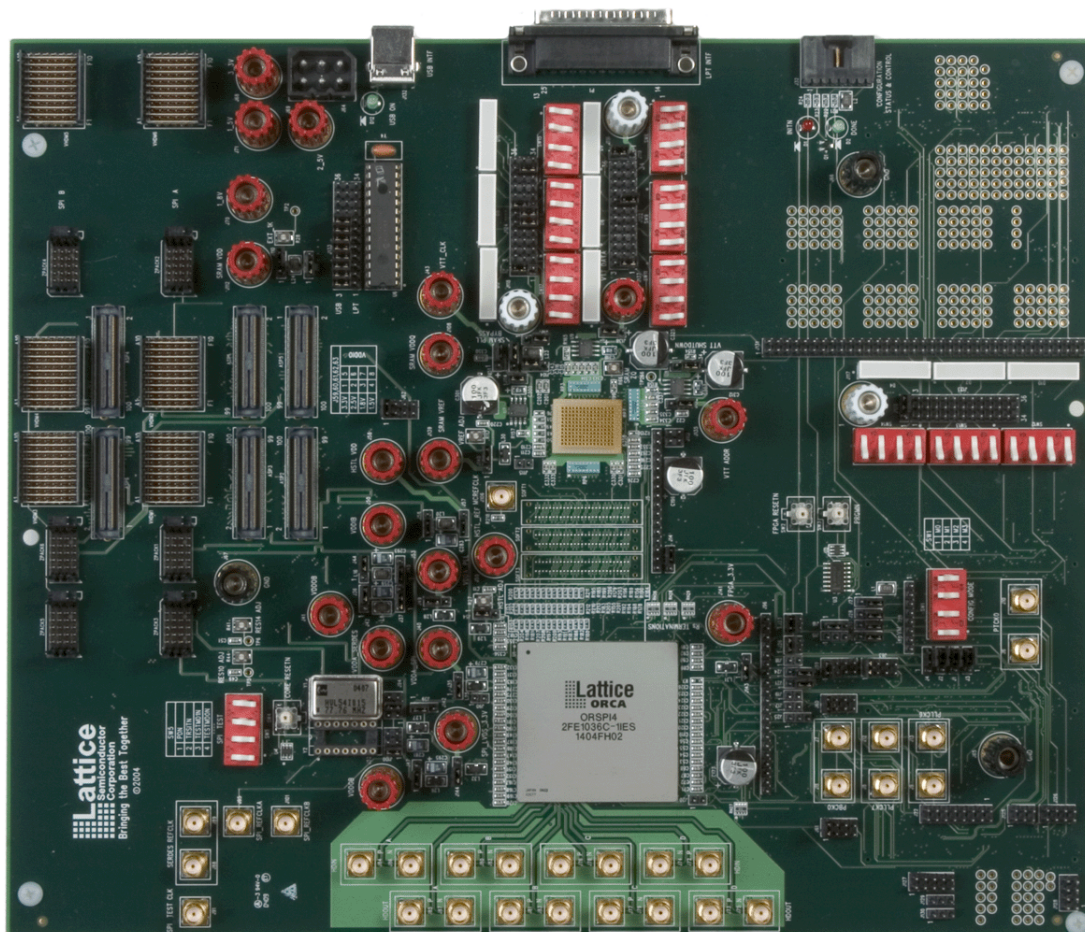
## Introduction

This user's guide describes the Lattice evaluation board for the ORSPI4 device, a stand-alone evaluation PCB that provides a functional platform for device feature demonstrations. The board includes the following features:

- Power connections
- ispVM<sup>®</sup> programming support
- On-board and external reference clock sources
- High-speed interconnections to both SPI4.2 compliant interfaces
- SPI4.2 interface logic analyzer connections
- Quad Data Rate memory controller interface to SRAM device
- Discrete high-speed interface SMA test points and clock connections
- ORCAstra Demonstration Software interface
- SERDES high-speed layout structures

The contents of this user's guide include top-level functional descriptions of the various portions of the evaluation board, descriptions of the connectors, diodes and switches and a complete set of schematics for version 1.2 of the board. Figure 1 shows the functional partitioning of the board.

**Figure 1. ORSPI4 Evaluation Board**



## J29

An 8-pin connector that provides the interface to the ispDOWNLOAD<sup>®</sup> cable.

Pin Number	Signal
Pin 1	VDD
Pin 2	TDO
Pin 3	TDI
Pin 4	NC
Pin 5	NC
Pin 6	TMS
Pin 7	GND
Pin 8	TCK

## J32

A 7-pin serial connector used for serial configuration.

Pin Number	Signal
Pin 1	GND
Pin 2	NC
Pin 3	PROGRMN
Pin 4	DONE
Pin 5	D0
Pin 6	CCLK
Pin 7	VDD

## Header Connections

Standard 0.100 headers are provided for interconnecting points on the board. This can be accomplished with 0.100 IDC connectors and ribbon cable for bus connections or 0.025 pin socket patch cords (such as Pomona Electronics #5948 ([www.pomonelectronics.com](http://www.pomonelectronics.com))). 0.100 jumpers shunts are also used for board selections such as Sullins Electronics P/N SPC02SYAN ([www.sullinselectronics.com](http://www.sullinselectronics.com)).

## D1, D2

These LEDs indicate the status of configuration to the FPGA DONE/INITN status pins. When D2 is illuminated, this indicates the successful completion of configuration. Illumination of D1 indicates that the programming was aborted or reinitialized.

## J21, 24

These standard 3x1 headers provide connections of the PROGRAMN and RESETN control pins. For standard evaluation board use, a 2-pin shunt should be placed across pins 1 and 2. This will connect the pins to on-board push-button switches.

	Pin Number	Signal
J21	Pin 1	Local
	Pin 2	RESETN
	Pin 3	Global
J24	Pin 1	Local
	Pin 2	PROGRMN
	Pin 3	Global

**J23, 26**

These standard 2x2 headers provide connection of the DONE and INITN status pins. For standard evaluation board use, a 2-pin shunt should be placed across pins 1 and 2. This will connect the pins to on-board LED indicators.

	Pin Number	Signal
J23	Pin 1	Local
	Pin 2	DONE
	Pin 3	Global
	Pin 4	DONE
J26	Pin 1	Local
	Pin 2	INITN
	Pin 3	Global
	Pin 4	INITN

**J27, J28, J30, J31**

These standard 1x3 header provide connection of the JTAG pins to the ispVM down connection. For standard evaluation board use, a 2-pin shunt should be placed across pins 2 and 3. This will connect the pins to J30.

	Pin Number	Signal
J27	Pin 1	Global
	Pin 2	TDO
	Pin 3	Local
J28	Pin 1	Global
	Pin 2	TDI
	Pin 3	Local
J30	Pin 1	Global
	Pin 2	TMS
	Pin 3	Local
J31	Pin 1	Global
	Pin 2	TCK
	Pin 3	Local

## J1, J2, J3, J4

These standard 1x3 header provide connection of the configuration MODE pins to the on board DIP switches. For standard evaluation board use, a 2-pin shunt should be placed across pins 2 and 3.

	Pin Number	Signal
J1	Pin 1	Global
	Pin 2	Mode1
	Pin 3	Local
J2	Pin 1	Global
	Pin 2	Mode2
	Pin 3	Local
J3	Pin 1	Global
	Pin 2	Mode3
	Pin 3	Local
J4	Pin 1	Global
	Pin 2	Mode0
	Pin 3	Local

## J14, J15, J16, J25

These standard 1x3 headers connect CCLK, DIN, RDCFGN, PTEMP pins.

	Pin Number	Signal
J14	Pin 1	DATA0
	Pin 2	DIN
	Pin 3	CABLE
J15	Pin 1	PROM
	Pin 2	CCLK
	Pin 3	CABLE
J16	Pin 1	3.3V
	Pin 2	RDCFGN
	Pin 3	CABLE
J25	Pin 1	3.3V
	Pin 2	PTEMP
	Pin 3	GND

## Control Switches

The following switches provide the user control of the various control pins.

Switch	Use	Notes
SW1	Configuration Mode Pins[3:0]	A=M0,B=M1,C=M2,D=M3
SW2		Pushbutton for RESETN
SW3		Pushbutton for PROGMN
SW4		Pushbutton for PASB_RESETN(SERDES RESET)
SW5	Test pins	A=PDN, B=TRISTN, C=TESTMD1N, D=TESTMD0N

## J17, J18, J19

These 2x1 standard headers allows connection of the Chip Selects to various sources. For standard evaluation board use, place shunt across J17, J18=OPEN, J19, pins 1 and 2.

	Pin Number	Signal
J17-CS0N	Pin 1	3.3V
	Pin 2	CS1
J18-CS1	Pin 1	CS0N
	Pin 2	GND
J19-CS0N	Pin 1	Source
	Pin 2	CS1

## J20

These 2x1 standard headers allows connection of the LVDS\_R pin to a 100Ω resistor to GND. For standard evaluation board use, leave header open.

Pin Number	Signal
Pin 1	100Ω
Pin 2	LDVS_R

## General Purpose FPGA I/O Selection

These 12x3 standard headers allow connection of the DIP switch packs or LEDs to general purpose I/O pins.

Pin Number	Signal
J122	GEN_FPGA[0:11]
J123	GEN_FPGA[24:35]
J124	GEN_FPGA[12:23]

## General Purpose Switch Selection

These 3x1 standard headers allows connection of the DIP switch packs to either an externally supplied voltage or the on-board 2.5V source.

Switch	Selections
J119	GEN_FPGA_SWITCH_SEL[0:11]
J120	GEN_FPGA_SWITCH_SEL[24:35]
J121	GEN_FPGA_SWITCH_SEL[12:23]

## General Purpose LED Selection

These 3x1 standard headers allows connection of the LED packs to the designated FPGA pin.

LED Bank	Selections
D3	LED array connected to J94-General IO[0:3]
D4	LED array connected to J95-General IO[24:27]
D5	LED array connected to J100-General IO[12:15]
D6	LED array connected to J94-General IO[4:7]
D7	LED array connected to J95-General IO[28:31]
D8	LED array connected to J100-General IO[16:19]
D9	LED array connected to J94-General IO[8:11]
D10	LED array connected to J95-General IO[32:35]
D11	LED array connected to J100-General IO[20:23]

## General Purpose I/O Connections

The 12x3 headers are jumper programmable to connect a particular FPGA pin to either a switch or a LED. The table below provides the connectivity to the device pins.

Net	Pad	BGA	Header	Switch	Device	LED
GEN_FPGA_PIN0	PB34C	BA22	J122	1	2	3
GEN_FPGA_PIN1	PB34D	BB22	J122	4	5	6
GEN_FPGA_PIN2	PB35A	AW22	J122	7	8	9
GEN_FPGA_PIN3	PB35B	AY22	J122	10	11	12
GEN_FPGA_PIN4	PB35C	BD21	J122	13	14	15
GEN_FPGA_PIN5	PB35D	BC21	J122	16	17	18
GEN_FPGA_PIN6	PB36C	BD20	J122	19	20	21
GEN_FPGA_PIN7	PB36D	BC20	J122	22	23	24
GEN_FPGA_PIN8	PB37A	AY21	J122	25	26	27
GEN_FPGA_PIN9	PB37B	AW21	J122	28	29	30
GEN_FPGA_PIN10	PB37C	BB20	J122	31	32	33
GEN_FPGA_PIN11	PB37D	BA20	J122	34	35	36
GEN_FPGA_PIN12	PB38A	BA21	J124	1	2	3
GEN_FPGA_PIN13	PB38B	BB21	J124	4	5	6
GEN_FPGA_PIN14	PB38C	BD19	J124	7	8	9
GEN_FPGA_PIN15	PB38D	BC19	J124	10	11	12
GEN_FPGA_PIN16	PB39A	AY20	J124	13	14	15
GEN_FPGA_PIN17	PB39B	AW20	J124	16	17	18
GEN_FPGA_PIN18	PB39C	BB19	J124	19	20	21
GEN_FPGA_PIN19	PB39D	BA19	J124	22	23	24
GEN_FPGA_PIN20	PB40A	AY19	J124	25	26	27
GEN_FPGA_PIN21	PB40B	AW19	J124	28	29	30
GEN_FPGA_PIN22	PB40C	BD18	J124	31	32	33
GEN_FPGA_PIN23	PB40D	BC18	J124	34	35	36
GEN_FPGA_PIN24	PB41A	AY18	J123	1	2	3
GEN_FPGA_PIN25	PB41B	AW18	J123	4	5	6
GEN_FPGA_PIN26	PB41C	BB18	J123	7	8	9

Net	Pad	BGA	Header	Switch	Device	LED
GEN_FPGA_PIN27	PB41D	BA18	J123	10	11	12
GEN_FPGA_PIN28	PB42A	AY17	J123	13	14	15
GEN_FPGA_PIN29	PB42B	AW17	J123	16	17	18
GEN_FPGA_PIN30	PB42C	BD17	J123	19	20	21
GEN_FPGA_PIN31	PB42D	BC17	J123	22	26	24
GEN_FPGA_PIN32	PB43A	AY16	J123	25	23	27
GEN_FPGA_PIN33	PB43B	AW16	J123	28	29	30
GEN_FPGA_PIN34	PB43C	BB17	J123	31	32	33
GEN_FPGA_PIN35	PB43D	BA17	J123	34	35	36

### Non-Applicable Headers

Standard headers are used for lab purpose only and are left unused for standard evaluation board use.

Location	Description
J125	HEADER 16X1
J126	HEADER 8X2
J102	HEADER 3x2
J103	HEADER 2x4
J104	HEADER 5X2
J105	HEADER 2x4
J106	HEADER 3x1
J107	HEADER 3x1

### SERDES/SPI4 and QDR Memory Controller Voltage Supply Selections

These 3x1 standard headers are used for selecting voltage sources for the following power supplies.

Header	Pin1	Pin2	Pin3	Default Shunt
J39	1.5V	VDDA	Banana	1-2
J47	VDDA	VDDGB	Banana	1-2
J44	1.8V	VDDIB	1.5V	2-3
J45	On-Board	VDDIB	Banana	1-2
J36	1.8V	VDDOB	1.5V	2-3
J37	On-Board	VDDOBA	Banana	1-2
J35	On-Board	VDDA_SPI	Banana	1-2
J49	On-Board	VDDA_PLL	Banana	1-2
J56	1.5V	VDDH	1.8V	1-2
J57	On-Board	VDDH	Banana	1-2
J54	On-Board	REF_I	Banana	1-2



## VDDIO

These standard 2x4 headers select the input for the VDDIO voltage. Placing shunts connects the specified voltage level to the associated VDDIO bank and are as follows.

Header	VDDIO Bank
J59	VDDIO7
J60	VDDIO6
J61	VDDIO5
J62	VDDIO1
J63	VDDIO0

5	1	3.3V
6	2	2.5V
7	3	1.8V
8	4	1.5V

VDDIO Selection

## ORCAstra PC Interface

### J133

The standard 12x3 headers select the input for the ORCAstra demo interface. Placing shunts connects the specified source, either LPT or USB communications of a PC. Placing shunts across 2-3, 5-6, 8-9, 11-12, 14-15, 17-18, 20-21, 23-24 will connect the USB to the interface.

The following designators are used to interface with the ORCAstra GUI:

Jack #	Size	Function
D12	LED	Green LED indicates USB connected for ORCAstra
J132	4-pin	Universal Serial Bus (USB) ORCAstra Interface
P1	24-pin	Parallel Port (LPT) ORCAstra Interface

## External SERDES REFCLK

These SMA connectors connect to the reference clock pins of the SERDES. These pins receive a direct differential reference clock.

SMA Connector	SERDES Clock
J88	REFCLKA_N
J89	REFCLKA_P

## On-Board SPI REFCLK

These DIP sockets connect an oscillator for the SPI reference clocks.

Socket	SERDES Clock	Type	Description
Y1	REFCLKA	4-pin DIP	Oscillator for REFCLKA
Y2	REFCLKB	4-pin DIP	Oscillator for REFCLKB

## SERDES Channels

These SMA connectors connect to the SERDES Tx and Rx channels of the SERDES.

SMA Connector	SERDES Channel
J72	HDIN_D_P
J73	HDOUT_D_P
J74	HDIN_D_N
J75	HDOUT_D_N
J76	HDIN_C_P
J77	HDOUT_C_P
J78	HDIN_C_N
J79	HDOUT_C_N
J80	HDIN_B_P
J81	HDOUT_B_P
J82	HDIN_B_N
J83	HDOUT_B_N
J84	HDIN_A_P
J85	HDOUT_A_P
J86	HDIN_A_N
J87	HDOUT_A_N

## Additional Connections

SMA connectors are available to connect to several FPGA clock pins.

SMA	Signal	BGA Pin
J6	PTCK0T	C30
J7	PTCK0T	BC28
J8	PLL_CK7C	AT40
J9	PLL_CK6C	BD42
J10	PTCK0C	D30
J11	PTCK0C	BD28
J12	PLL_CK7T	AT39
J13	PLL_CK6T	BC42

SMA connection for SPI4.2 Test clock.

SMA	Signal	BGA Pin
J91	TESTCLK	BD4

Additional FPGA pins

<b>BGA</b>	<b>Signal</b>	<b>J96 Pin</b>
D20	PT44C	1
C20	PT44D	2
E23	PT44B	3
F23	PT44A	4
E20	PT43D	5
BD13	PB44A	6
BC13	PB44B	7
BD16	PB44C	8
BC16	PB44D	9
BB16	PB45C	10
BA16	PB45D	11
BD12	PB46A	12
BC12	PB46B	13
BD14	PB46C	14
BD15	PB46D	15
AR40	PL45C	16
AR41	PL45D	17
AT41	PL46C	18
AU41	PL46D	19

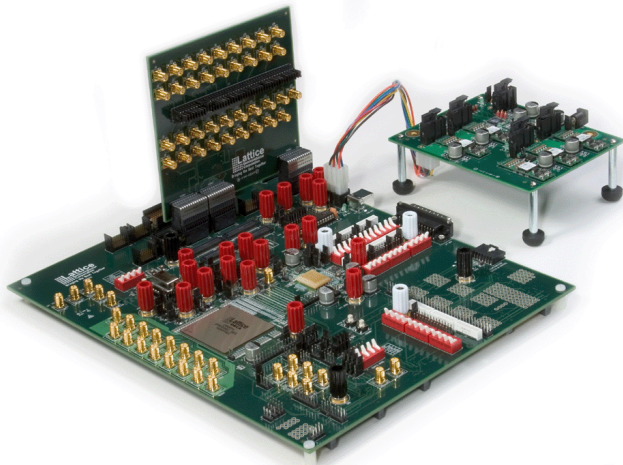
## External Power Supply Connections

The following banana jack connectors are available for supplying power to the evaluation board from an external source:

Connector	Type	External	Typical Voltage
J42	Red Binding Post	VDDA	+1.5V
J52	Red Binding Post	VDDGB	+1.5V
J50	Red Binding Post	VDDIB	+1.5V/1.8V
J41	Red Binding Post	VDDOB	+1.5V/1.8V
J58	Red Binding Post	HSTL_VDD	+1.5V/1.8V
J53	Red Binding Post	VDDA_PLL	+3.3V
J55	Red Binding Post	HSTL_VREF	+0.75/0.9V
J141	Red Binding Post	FPGA_VDD33	+3.3V
J142	Red Binding Post	SPI_LVDS_3.3V	+3.3V
J68	Red Binding Post	VDD33	+3.3V
J69	Red Binding Post	VDD25	+2.5V
J70	Red Binding Post	VDD18	+1.8V
J71	Red Binding Post	VDD15	+1.5V
J116	White Binding Post	GEN_FPGA[0:11]	Input Pad Dependent
J118	White Binding Post	GEN_FPGA[12:23]	Input Pad Dependent
J117	White Binding Post	GEN_FPGA[34:35]	Input Pad Dependent
J65	Black Binding Post	GND	Negative supply
J66	Black Binding Post	GND	Negative supply
J67	Black Binding Post	GND	Negative supply
J112	Red Binding Post	QDR SRAM VDD	Positive supply(+1.5V-1.8V)
J108	Red Binding Post	SRAM VDDQ	Positive supply(+1.5V-1.8V)
J139	Red Binding Post	SRAM VREF	Positive supply(+0.75-0.9V)

A Molex 6-pin power connector (J64) is provided for interconnection of a power module (GL009). This module integrates the ispPAC<sup>®</sup>-POWR1208 device and specified power regulator devices to provide adequate +1.5V, +1.8V, +2.5V, and +3.3V rails to supply this board via a standard wall-transformer module. Figure 2 highlights the connection between the evaluation and the PWR1208 power module board.

**Figure 2. ORSPI4 Evaluation Board with Power Module (ICM) Board**



## SPI4.2

### SPI Reference Clocks

#### J95 and J217

These 2x3 standard headers connect the reference clock pins of the SPI to an on-board oscillator or a direct differential reference clock sourced from SMA.

	Pin	
J94	Pin 1, 3, 5	REFCLKA
	Pin 2	OSC
	Pin 4	External SMA
J100	Pin 1, 3, 5	REFCLKB
	Pin 2	OSC
	Pin 4	External SMA

### SPI4.2 Interoperability Connections

#### VHDM 1 -6

These high-speed connectors provide an interface of the SPI4.2 signals. They can provide capabilities to interconnect the evaluation board to other vendor boards. The Molex VHDM 6-row connector provides both daughter card and cable interconnections.

#### ASP 1 -6

High-speed logic analyzer connectors are provided to observe the SPI4.2 interface. The Samtec connectors are provided to connect to an Agilent Logic Analyzer. Because the SPI4.2 bus uses LVDS, the POS-PHY L4 Toolset provided for the Agilent 16760A logic analyzer and the E5379A probes provides capabilities to capture data synchronously on the transmit and receive paths which includes a clock, a 16-bit data bus and control signals.

### QDR Memory Controller Interface

A dedicated interface is included to a 165-BGA QDR memory device. This interface includes proper termination for data, address, and control of a Quad-data rate SRAM device. It also includes the ability to observe transactions through a logic analyzer interconnection.

SMA	Signal	BGA Pin
J106	Memory Controller Ref. Clock	E13

### Technical Support Assistance

Hotline: 1-800-LATTICE (North America)

+1-408-826-6002 (Outside North America)

e-mail: [techsupport@latticesemi.com](mailto:techsupport@latticesemi.com)

Internet: [www.latticesemi.com](http://www.latticesemi.com)

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- Оценку стоимости проекта по компонентам.
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