



## LatticeECP3 PCI Express Solutions Board – Revision A

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### User's Guide

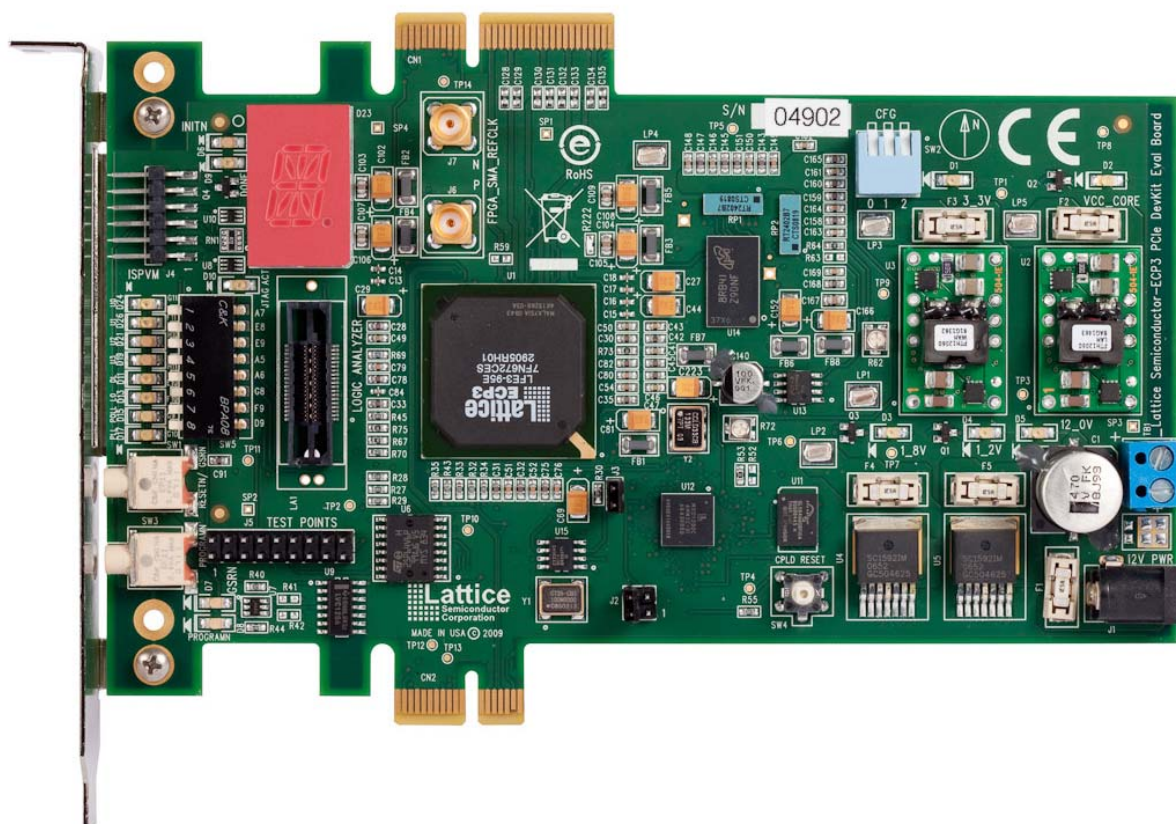
## Introduction

As PCI Express applications have emerged, the LatticeECP3™ FPGA family has become a well-suited solution for many system designs. The features of the LatticeECP3 PCI Express Solutions Board can assist engineers with rapid-prototyping and testing their designs. The board is an enhanced form-factor of the PCI Express add-in card specification. It allows for full x1 form-factor compliance and x4 is available for demonstration purposes with some non-standard form-factor issues. The flexibility to use the same board to demonstrate both x1 and x4 configurations is accomplished by simply changing the mounting hardware. The board has several debugging and analyzing features for complete evaluation of the LatticeECP3 device. This guide is intended to be referenced in conjunction with evaluation design tutorials to demonstrate the LatticeECP3 FPGA.

This user's guide describes the LatticeECP3 PCI Express Solutions Board featuring the LatticeECP3 LFE3-95EA-FN672 FPGA. The stand-alone evaluation board provides a functional platform for development and rapid prototyping of applications that require high-speed SERDES interfaces to demonstrate PCI Express capabilities using an add-on card form-factor. The board is manufactured using standard FR4 dielectric and through-hole vias. The nominal impedance is 50-ohm for single-ended traces and 85-ohm for differential traces.

**Important:** This document (including the schematics in the appendix) describes LatticeECP3 PCI Express Solutions Boards marked as **Rev A**. This marking can be seen on the silkscreen of the printed circuit board, under the Lattice Semiconductor logo.

**Figure 1. LatticeECP3 PCI Express Solutions Board**

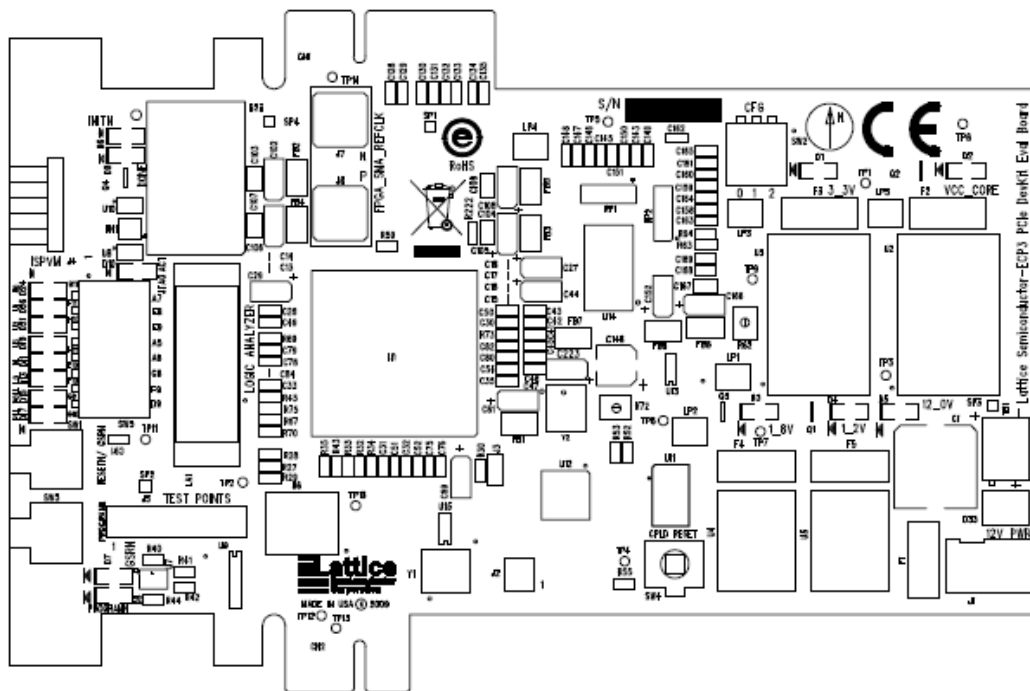


## Features

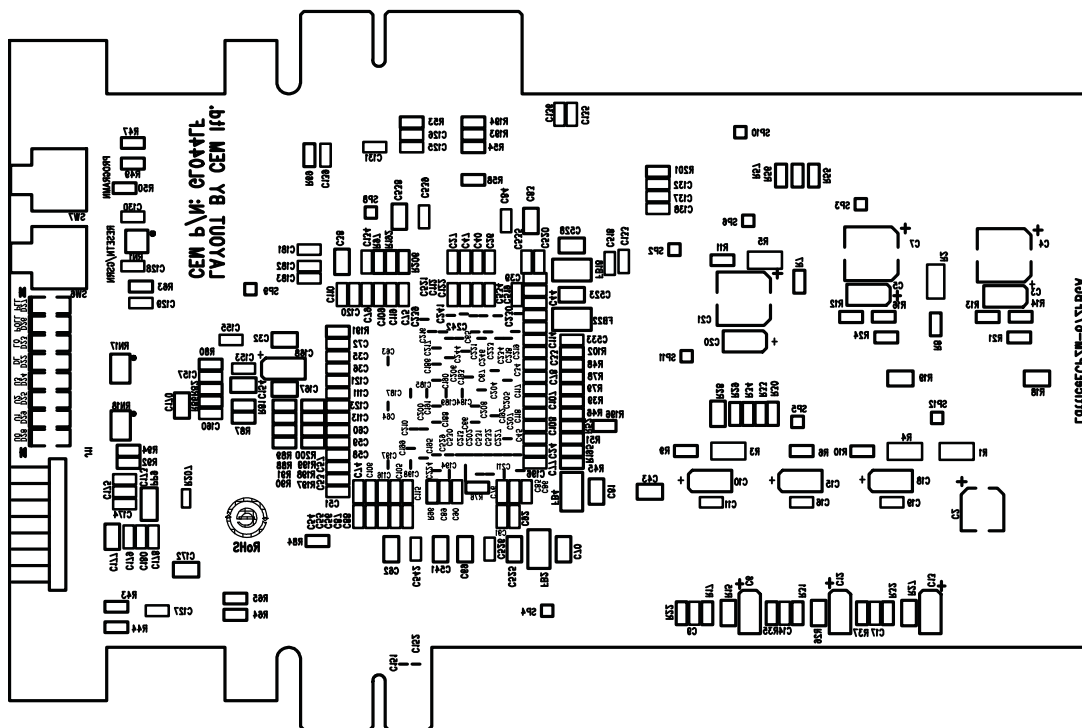
- PCI Express x1 and x4 edge connector interfaces
- Allows demonstration of PCI Express (x 1 and x4) interfaces
  - x1 is form-factor compliant and will fit a standard PC-equipped PCI Express motherboard socket
  - x4 is non-compliant but will demonstrate x4 functionality by a simple change to the hardware
- Allows control of SERDES PCS registers using the Serial Client Interface (ORCAstra)
- On-board Boot Flash
  - Both Serial SPI Flash and Parallel Flash via MachXO™ programming bridge
- Shows interoperation with a high performance DDR2 memory component
- Includes driver based “run-time” device configuration capability via ORCAstra or PCI Express
- Switches, LEDs, displays for demo purposes
- Input connection for lab-power supply
- Power connections and power sources
- ispVM™ programming support
- On-board and external reference clock sources

The contents of this user's guide include top-level functional descriptions of the various portions of the evaluation board, descriptions of the on-board connectors, diodes and switches and a complete set of schematics of the board.

**Figure 2. PCI Express Solutions Board Outline Drawing, Top Side**



**Figure 3. PCI Express Solutions Board Outline Drawing, Bottom Side**

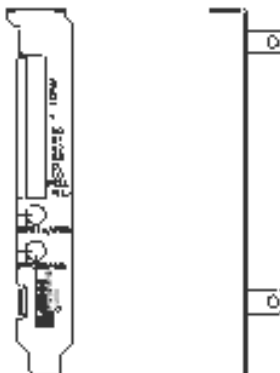


## x1 and x4 PCI Express Support

PCI Express x1 and x4 is supported with the same PCB. This add-in PCB is designed to work in both types of motherboard slots. The PCB complies with the width and length dimensions of the PCI Express Card Electromechanical (CEM) Specification Revision 1.1. The only exclusion of the CEM specification is the component and back side of the add-in board may interfere with other boards in a fully-populated motherboard.

This board is easily interchanged from x1 to x4 configurations by removing the back-panel bracket and reinstalling it on the opposite side. This permits plug-in into PCI Express sockets on the motherboard and securing it in the chassis if desired. The back-panel bracket is shown below.

**Figure 4. Back Panel Drawing**



## LatticeECP3 Device

This board features a LatticeECP3 FPGA with a 1.2V core supply. It can accommodate all pin compatible LatticeECP3 devices in the 672-ball fpBGA (1mm pitch) package. A complete description of this device can be found in the LatticeECP3 Family Data Sheet on the Lattice website at [www.latticesemi.com](http://www.latticesemi.com).

*Note: The connections referenced in this document refer to the LFE3-95EA-FN672 device. Available I/Os and associated sysI/O™ banks may differ for other densities within this device family.*

## Applying Power to the Board

The LatticeECP3 PCI Express Solutions Board is ready to power on. The board can be supplied with power from an AC wall-type transformer power supply shipped with the board. Or it can be supplied from a benchtop supply via terminal screw connections. It also has provisions to be supplied from the PCI Express edge fingers from a host board.

To supply power from the factory-supplied wall transformer, simply connect the output connection of the power cord to J1 and plug the wall-transformer into an AC wall-outlet.

## Power Supplies

(see Appendix A, Figure 21)

The evaluation board incorporates an alternate scheme to provide power to the board. The board is equipped to accept a main supply via the TB1 connection. This connection is provided to use with a benchtop supply adjusted to provide a nominal +12V DC.

All input power sources and on-board power supplies are fused with surface-mounted fuses and have green LEDs to indicate power GOOD status of the intermediate supplies

**Table 1. Board Power Supply Fuses (see Appendix A, Figure 21)**

|    |                    |
|----|--------------------|
| F1 | 12V Fuse           |
| F2 | 1.2V Core Fuse     |
| F3 | 3.3V Fuse          |
| F4 | 1.8V Fuse          |
| F5 | 1.2V Analog Supply |

**Table 2. Board Power Supply Indicators (see Appendix A, Figure 21)**

|    |                                     |
|----|-------------------------------------|
| D1 | 3.3V Source Good Indicator          |
| D2 | 1.2V VCC Core Source Good Indicator |
| D3 | 1.8V Source Good Indicator          |
| D4 | 1.2V Analog Source Good Indicator   |
| D5 | 12V Input Good Indicator            |

External power can be alternatively connected rather than the wall transformer power pack.

**Table 3. External Board Supply Input Terminal (see Appendix A, Figure 21)**

|     |                                                                              |
|-----|------------------------------------------------------------------------------|
| TB1 | Screw terminal for +12V DC<br>Pin1 (square PCB pad): +12V DC<br>Pin2: Ground |
|-----|------------------------------------------------------------------------------|

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## PCI Express Power Interface

Power can be sourced to the board via the PCB edge-fingers (CN1 and CN2). This interface allows the user to provide power from a PCI Express Host board.

## Programming/FPGA Configuration

(see Appendix A, Figure 23)

A programming header is provided on the evaluation board, providing access to the LatticeECP3 JTAG port.

## ispVM Download Interface

J4 and J8 are 6-pin JTAG connectors used in conjunction with the ispVM USB download cable to program and control the device. These connectors are available through the back-panel bracket as needed for x1 or x4 PCI Express configurations. These connectors are used in conjunction with the ispVM programming cable and software to program the configuration memory or FPGA directly.

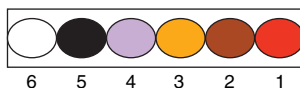
**Table 4. Standard ispVM Programming Cable Configuration**

|       |     |
|-------|-----|
| Pin 1 | VCC |
| Pin 2 | TDO |
| Pin 3 | TDI |
| Pin 4 | TMS |
| Pin 5 | GND |
| Pin 6 | TCK |

After initial board setup, use the following procedure to program the evaluation board. Instructions assume ispVM software has been installed on a local PC.

Connect the ispDOWNLOAD cable rainbow colored flywires to the connector J4.

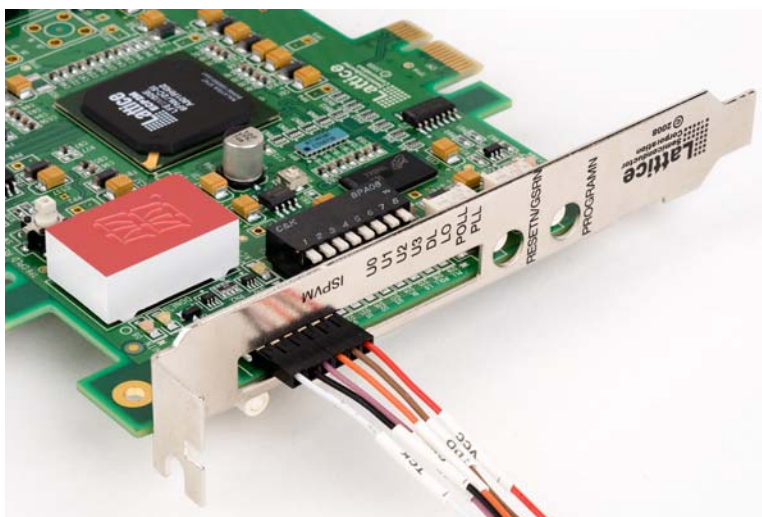
**Table 5. ispVM JTAG Connector (see Appendix A, Figure 21)**



Note: A dot denotes PIN 1 on the both the PCB or back-panel bracket.

| Pin | Function | Color  |
|-----|----------|--------|
| 1   | PWR      | Red    |
| 2   | TDO      | Brown  |
| 3   | TDI      | Orange |
| 4   | TMS      | Purple |
| 5   | GND      | Black  |
| 6   | TCK      | White  |

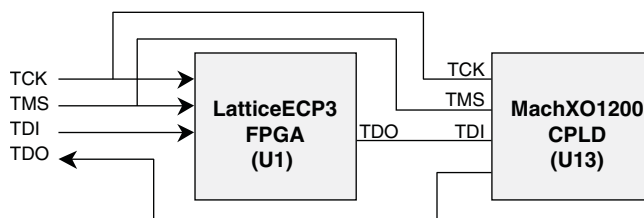
**Figure 5. ispVM Programming Cable Connector**



## Programming the Daisy Chain

This board includes two Lattice Semiconductor programmable (U1=LFE3-95, U12=LCMXO1200) devices that can be programmed in a daisy chain.

**Figure 6. JTAG Chain**



## Download Procedures

### Requirements:

- PC with ispVM System v.17.7 (or later) programming management software, installed with appropriate drivers (USB driver for USB Cable, Windows NT/2000/XP parallel port driver for ispDOWNLOAD Cable).

*Note: An option to install these drivers is included as part of the ispVM System setup.*

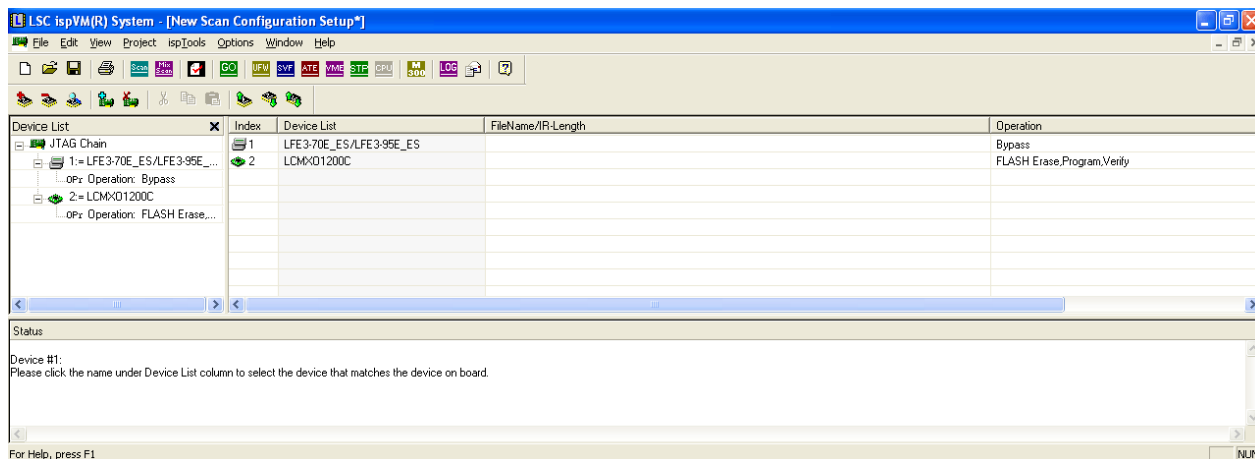
- ispDOWNLOAD Cable (pDS4102-DL2A, HW7265-DL3A, HW-USB-1A, etc.)

### JTAG Download

The LatticeECP3 device can be configured easily via its JTAG port. The device is SRAM-based; it must remain powered on to retain its configuration when programmed in this fashion.

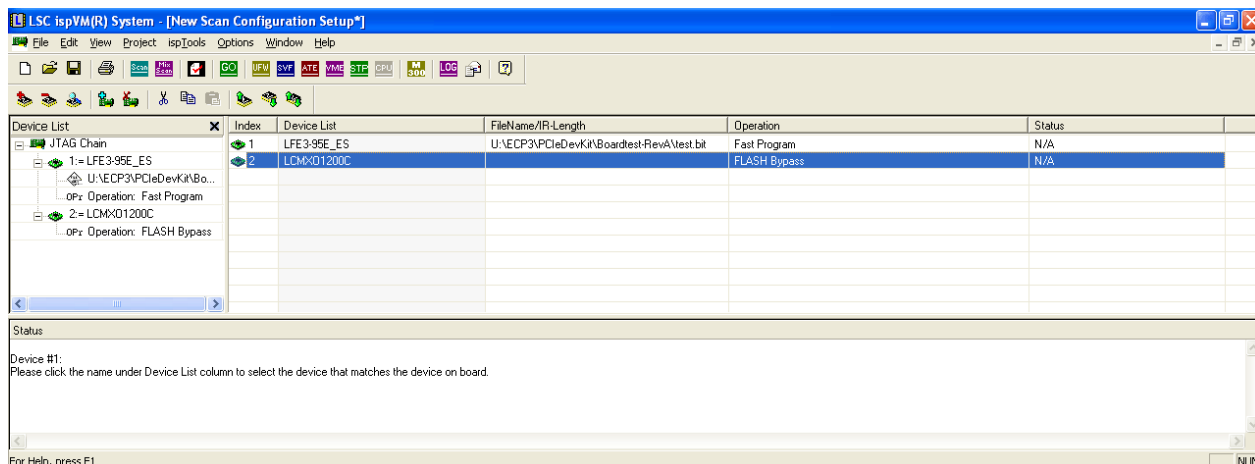
1. Connect the LatticeECP3 PCI Express Solutions Board to the appropriate power sources and power up board.
2. Connect the ispDOWNLOAD cable to the appropriate header. J4 is used for the 1x6 connection. J8 is used in the same manner for x4 configurations.
3. Start the ispVM System software.
4. Press the **SCAN** button located in the toolbar. The LatticeECP3 and the MachXO1200 devices should be automatically detected.

**Figure 7. ispVM Main Window**

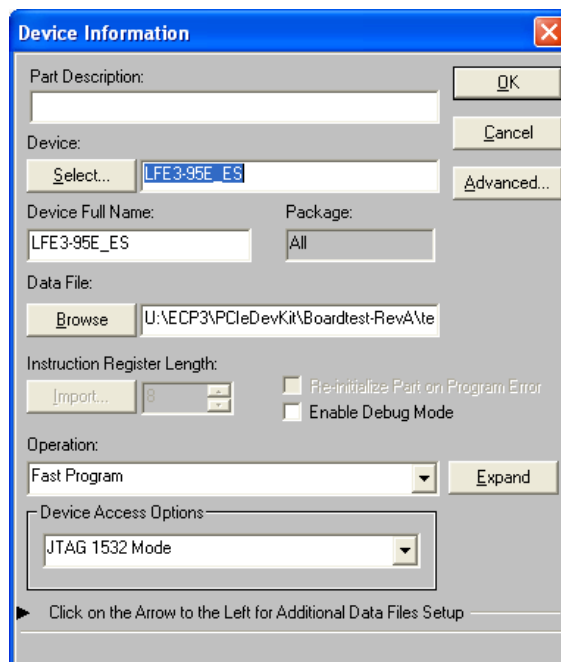


5. Double-click the device to open the device information dialog. In the device information dialog, click the **Browse** button located under **Data File**. Locate the desired bitstream file (.bit). Click **OK** to both dialog boxes.
6. To program only the LatticeECP3-95, place the LCMXO1200C device into **BYPASS** and the LFE3-95 should be in **FAST PROGRAM** mode.

**Figure 8. ispVM Fast Programming Mode**



**Figure 9. ispVM Device Information Dialog Box**



7. Add Data File.
8. Click the green **GO** button. This will begin the download process into the device. Upon successful download, the device will be operational.

### Configuration Status Indicators

(see Appendix A, Figure 23)

These LEDs indicate the status of configuration to the FPGA.

- D6 (red) illuminated, this indicates that the programming was aborted or reinitialized driving the INITN output low.
- D9 (green) is illuminated, this indicates the successful completion of configuration by releasing the open collector DONE output pin.

- D10 (green) will flash indicating TDI activity.
- D8 (red) illuminated, this indicates that PROGRAMN is low.
- D7 (red) illuminated, this indicates that GSRN is low.

### PROGRAMN & GSRN

(see Appendix A, Figure 23)

- These push-button switches assert/de-assert the logic levels on the PROGRAMN (SW3 or SW7) and GSRN (SW1 or SW6). Depressing the button drives a logic level “0” to the device.
- These push-buttons are accessible from the back panel if the evaluation board is mounted in a PCI Express slot of a PC.

### CFG [2:0]

(see Appendix A, Figure 23)

- The FPGA CFG pins are set on the board for a particular programming mode via the SW2 DIP switch.
- JTAG programming is independent of the MODE pins and is always available to the user.
- Pushing in (depressing) the switch is ON and sets the value to 0.

**Table 6. CFG Mode Selections**

| CFG2              | CFG1              | CFG0              | Configuration Mode |
|-------------------|-------------------|-------------------|--------------------|
| 0 (ON)            | 0 (ON)            | 0 (ON)            | SPI Flash          |
| 0 (ON)            | 1 (OFF)           | 0 (ON)            | SPIm               |
| 1 (OFF)           | 0 (ON)            | 1 (OFF)           | Slave Serial       |
| 1 (OFF)           | 1 (OFF)           | 1 (OFF)           | Slave Parallel     |
| X<br>(don't care) | X<br>(don't care) | X<br>(don't care) | ispJTAG™           |

### On-Board Serial SPI Flash Memory

(see Appendix A, Figure 23)

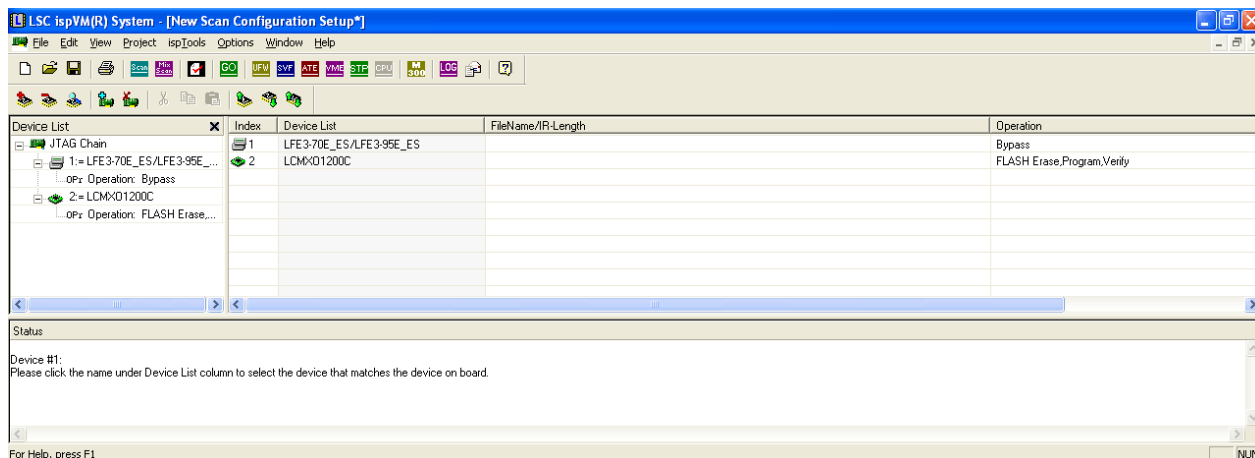
- One Serial SPI (16-pin tssop 64M) Flash memory device (U6) is on-board for non-volatile configuration memory storage. Either a STMicro M25P64VMF16 or Macronix MX25L6405 device is populated on-board.
- All CFG [2:0] need to be [000] depressed to read the Flash memory at power-up or after toggling the PROGRAMN pin.
- Install jumper across pins 2 and 4 on J2.

### Programming Serial SPI Flash Memory

The Serial SPI Flash memory device can be configured easily via its JTAG port. This mode enables the FPGA to be programmed at power-up or assertion of PROGRAMN with a bitstream stored in the memory device.

1. Connect the LatticeECP3 PCI Express Solutions Board to the appropriate power sources and power-up board.
2. Connect the ispDOWNLOAD cable to the appropriate header. J4 is used with the cable.
3. Start the ispVM System software.
4. Press the **SCAN** button located in the toolbar. The LFE3-95 and the LCMXO1200C devices should be automatically detected.

**Figure 10. Results of Scanning Board via ispVM**



- Double-click the **Operation** column for the LFE3-95 and the Device Dialog box shown below will open.
- In the dialog box, select the **SPI Flash Programming** mode in the **Device Access Options** pull-down menu. This will open the SPI Serial Flash Dialog box.

**Figure 11. Device Information Dialog Screen**

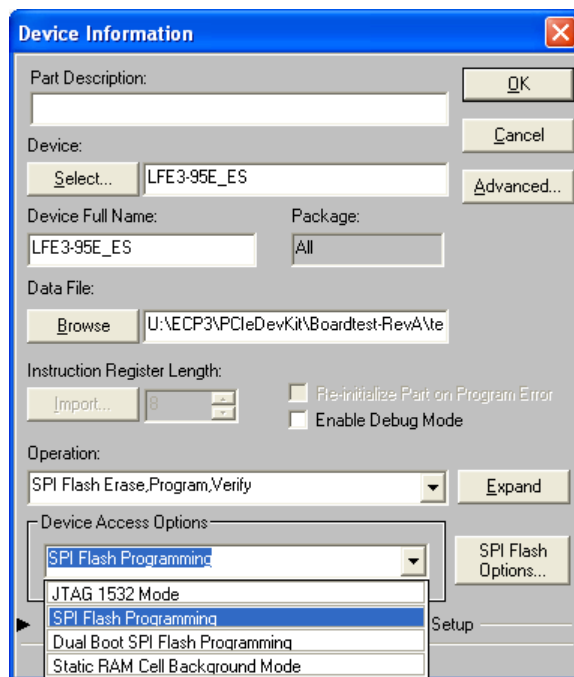
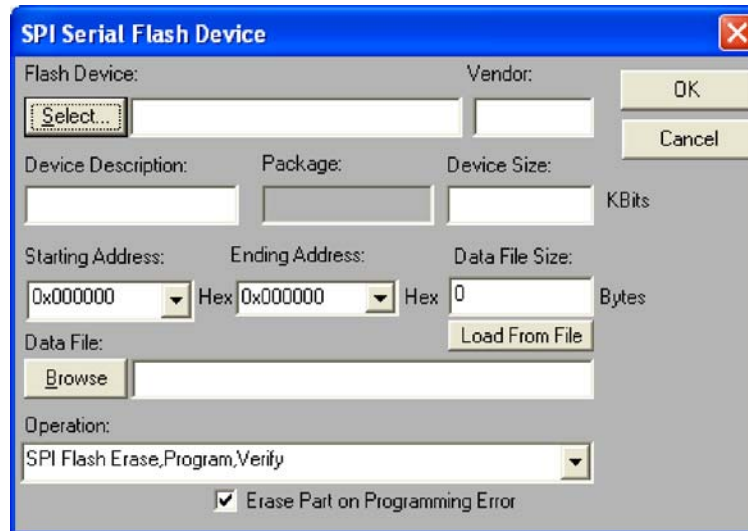


Figure 12. SPI Serial Flash Dialog Screen



7. The SPI Serial Flash Device dialog box will open. In this box select **SPI Flash Erase, Program, Verify** in the **Operation** pull-down menu.
8. Select **SPI Serial Flash** in the **Device Family** pull-down menu, **STMicro** under the **Vendor** pull-down menu, **SPI-M2564** under the **Device** pull-down menu, and **16-lead SOIC** under the **Package** submenu.

Figure 13. Select Device Dialog Box

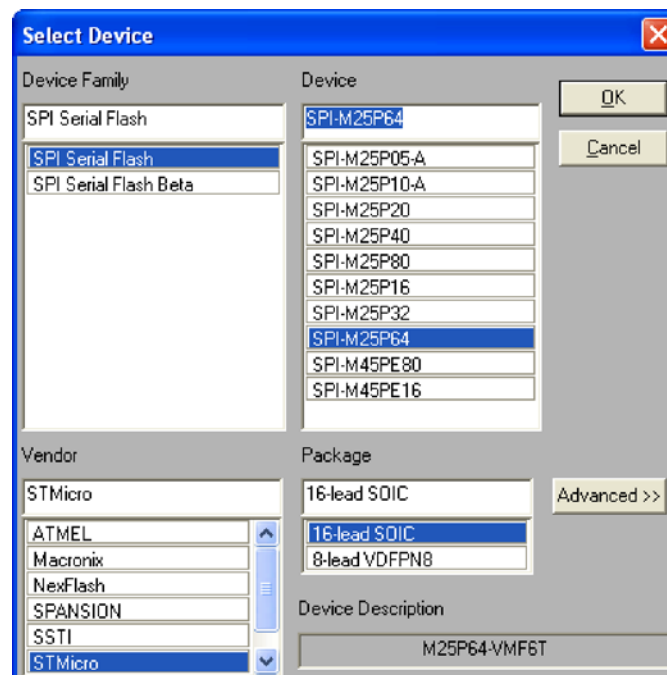
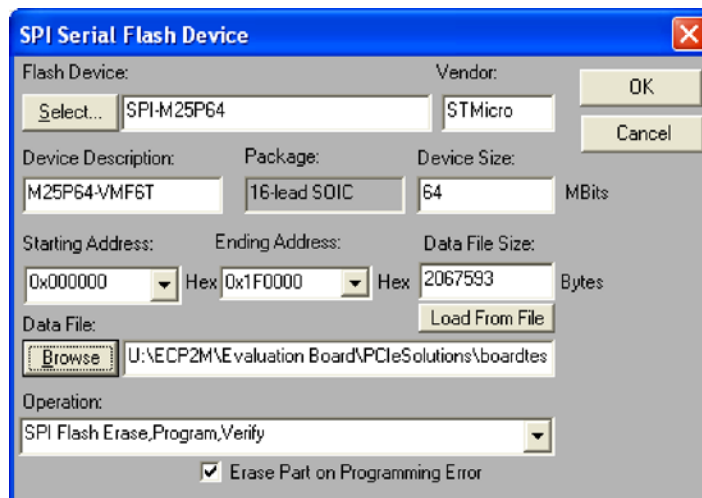
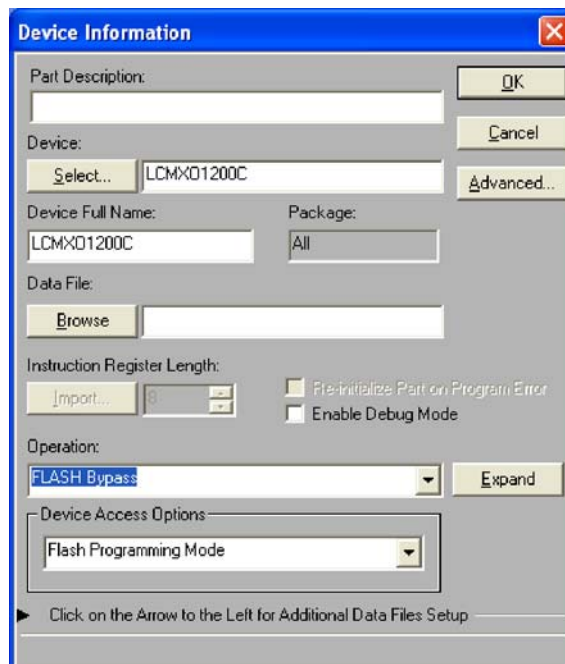


Figure 14. Sample SPI Serial Flash Device Dialog Box

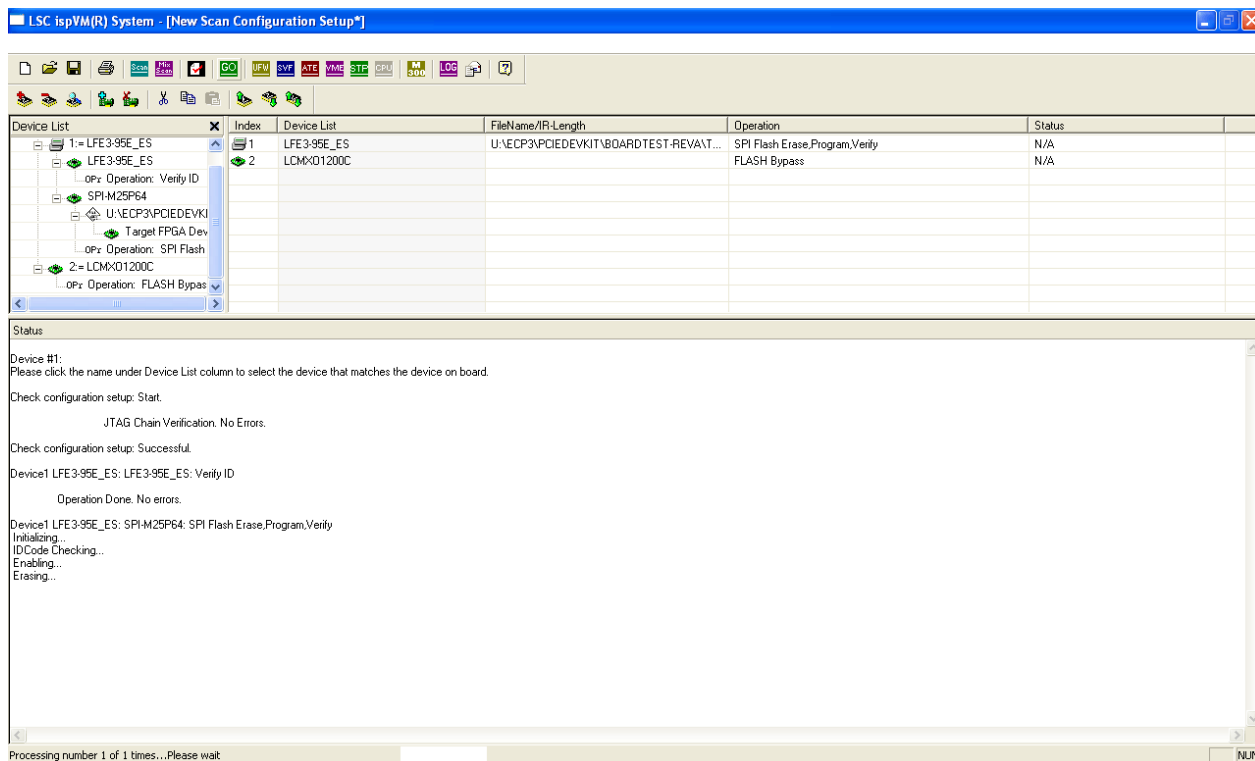


9. Click **OK** in the **SPI Flash Device** dialog box. Then click **OK** in the **Select Device** dialog box. You will then return to the main configuration screen. If you do not desire to load the LCMXO1200C device, this device should be placed in Flash Bypass mode by double-clicking the **Operation** column and selecting the **Bypass** operation shown below.

Figure 15. FLASH Bypass for LCMXO1200C Device



**Figure 16. Programming Main Window**

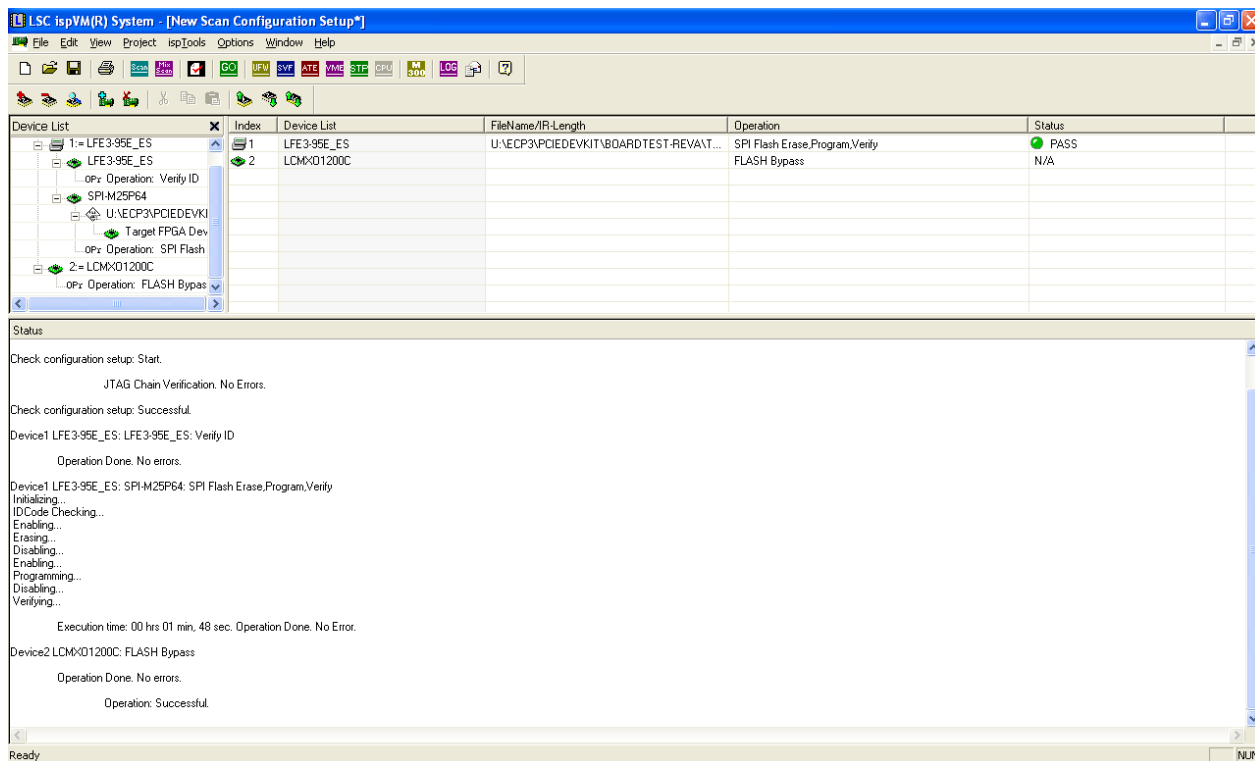


10. From the main programming window, select **GO** in the top toolbar. This will begin the SPI Serial Flash programming.

**Figure 17. SPI Serial Flash Programming Status Window**



**Figure 18. Successful SPI Serial Flash Programming Session**



### On-Board Parallel SPI Flash Memory

(see Appendix A, Figure 24)

- A 16-bit parallel Flash device is also available. This board uses a Lattice MachXO CPLD device to act as a programming bridge from the Flash device.
- The CFG [2:0] need to be [111], all up.
- Lattice ispVM programming software can be used to program either the serial SPI Flash or the parallel Flash devices. Application note AN8077, *Parallel Flash Programming and FPGA Configuration*, addresses the use of the parallel Flash implementation. *Note: For parallel Flash loading, the board needs the appropriate connections of J2. J2 requires a jumper be installed between pins 1 and 3.*

### User-Defined General Purpose Clock Oscillator

(see Appendix A, Figure 27, Y1)

A 100MHz oscillator is included on-board. It is fanned-out to several destinations on the board, as described in Table 7.

**Table 7. 100MHz Clock Destinations**

| Clock Destination | PCB Designation | Destination Pin   |
|-------------------|-----------------|-------------------|
| CPLD              | U12             | A8                |
| FPGA              | U1              | P21-PCLKT2_0      |
| FPGA              | U1              | K3-LLUM0-GDLLT_IN |
| FPGA              | U1              | M4-PCLKT7_0       |

## SERDES

(see Appendix A, Figure 25)

### SERDES/FPGA Reference Clocks

The 50-ohm terminated SMA connectors are optionally provided to supply reference clocks directly to the LatticeECP3 device. Please contact the factory for information to populate the PCB with SMA connectors.

**Table 8. SMA Inputs for External Clock Source**

| Connector | SERDES Signal    | FPGA Pin |
|-----------|------------------|----------|
| J6        | FPGA_SMA_REFCLKP | V20      |
| J7        | FPGA_SMA_REFCLKN | W19      |

### SERDES PCI Express Channels

(see Appendix A, Figure 25)

This board is equipped to communicate directly as an add-on card to a PCI Express host. It is designed with edge-fingers (CN1 or CN2) that fit directly into a PCI Express host receptacle. Power can be supplied directly from the PCI Express host via the edge-finger connections.

**Table 9. x1 PCI Express Connections**

| CML Pin Name  | FPGA Pin | PCIE      | PCI Express Edge | Description                                       |
|---------------|----------|-----------|------------------|---------------------------------------------------|
| PCSA_HDOUTP_0 | AF21     | PERp0     | A16              | Integrated endpoint block transmit pair           |
| PCSA_HDOUTN_0 | AF20     | PERn0     | A17              |                                                   |
| PCSA_HDINP_0  | AD21     | PETp0     | B14              | Integrated endpoint block receive pair            |
| PCSA_HDINN_0  | AD20     | PETn0     | B15              |                                                   |
| PCSA_REFCLKP  | AC17     | PCle_CLKp | A13              | Integrated endpoint block differential clock pair |
| PCSA_REFCLKN  | AC18     | PCle_CLKn | A14              |                                                   |
| PCIE_PERSETN  | U20      | PERSTN    | A11              | Fundamental PCI Express reset                     |

**Table 10. x4 PCI Express Connections**

| CML Pin Name  | FPGA Pin | PCIE  | PCI Express Edge | Description                             |
|---------------|----------|-------|------------------|-----------------------------------------|
| PCSB_HDOUTP_0 | AF13     | PERp0 | A16              | Integrated endpoint block transmit pair |
| PCSB_HDOUTN_0 | AF12     | PERn0 | A17              |                                         |
| PCSB_HDINP_0  | AD13     | PETp0 | B14              | Integrated endpoint block receive pair  |
| PCSB_HDINN_0  | AD12     | PETn0 | B15              |                                         |
| PCSB_HDOUTP_1 | AF10     | PERp1 | A21              | Integrated endpoint block transmit pair |
| PCSB_HDOUTN_1 | AF11     | PERn1 | A22              |                                         |
| PCSB_HDINP_1  | AD10     | PETp1 | B19              | Integrated endpoint block receive pair  |
| PCSB_HDINN_1  | AD11     | PETn1 | B20              |                                         |

**Table 10. x4 PCI Express Connections (Continued)**

| CML Pin Name  | FPGA Pin | PCIE      | PCI Express Edge | Description                                       |
|---------------|----------|-----------|------------------|---------------------------------------------------|
| PCSB_HDOUTP_2 | AF9      | PERp2     | A25              | Integrated endpoint block transmit pair           |
| PCSB_HDOUTN_2 | AF8      | PERn2     | A26              |                                                   |
| PCSB_HDINP_2  | AD9      | PETp2     | B23              | Integrated endpoint block receive pair            |
| PCSB_HDINN_2  | AD8      | PETn2     | B24              |                                                   |
| PCSB_HDOUTP_3 | AF6      | PERp3     | A29              | Integrated endpoint block transmit pair           |
| PCSB_HDOUTN_3 | AF7      | PERn3     | A30              |                                                   |
| PCSB_HDINP_3  | AD6      | PETp3     | B27              | Integrated endpoint block receive pair            |
| PCSB_HDINN_3  | AD7      | PETn3     | B28              |                                                   |
| PCSB_REFCLKP  | AC9      | PCle_CLKp | A13              | Integrated endpoint block differential clock pair |
| PCSB_REFCLKN  | AC10     | PCle_CLKn | A14              |                                                   |
| PCIE_PERSETN  | U20      | PERSTN    | A11              | Fundamental PCI Express reset                     |

### FPGA Test Pins

(see Appendix A, Figure 27)

### General Purpose DIP Switch

(see Appendix A, Figure 27, SW5)

General-purpose FPGA pins are available for user applications. FPGA pins are connected to a switch (SW5) which is an SPST side actuated DIP switch. The switch is physically located on the secondary side of the PCB along the back-panel edge. The switches are connected to a logic level 0 when depressed toward the board and a 1 when away from the board. The designated pins are connected according to Table 11.

**Table 11. FPGA Test Pins (See Appendix A, Figure 26)**

| FPGA BGA | SW5 Switch Position |
|----------|---------------------|
| D9       | 1                   |
| F9       | 2                   |
| G8       | 3                   |
| A6       | 4                   |
| A5       | 5                   |
| E9       | 6                   |
| E8       | 7                   |
| A7       | 8                   |

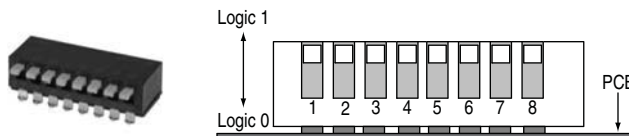
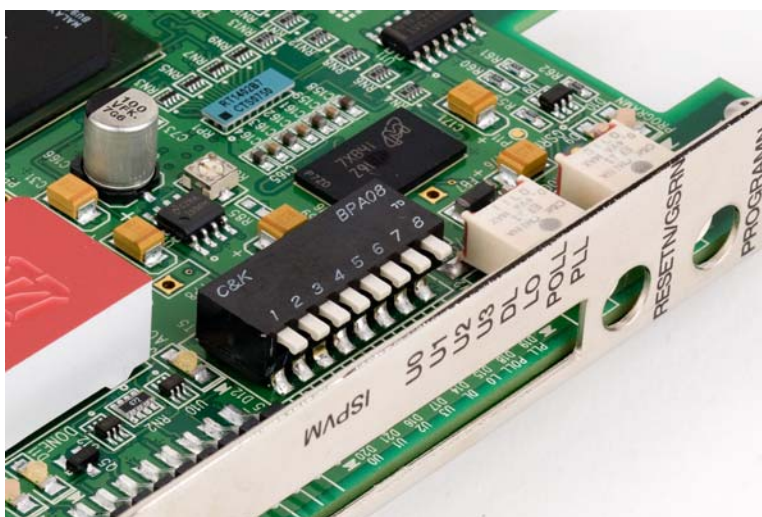


Figure 19. 8-position DIP Switch (SW5) on Secondary PCB Side



### General Purpose LEDs (see Appendix A, Figure 27)

LEDs are provided along the back panel edge of the PCB. These LEDs are connected to general-purpose FPGA I/Os. The LEDs are illuminated by the associated FPGA outputs being driven to a valid LOW level. The use of these LEDs is defined for PCI Express applications to observe the status of the PCI Express link during operation. The LEDs must be included in the FPGA design. These status LEDs are available in both x1 or x4 configurations. The back panel marking reflects PCI Express specific status.

Table 12. LED Definitions

| PCI Express x1 |                | PCI Express x4 |                |                        |
|----------------|----------------|----------------|----------------|------------------------|
| FPGA Pin#      | PCB Designator | FPGA Pin#      | PCB Designator | Description            |
| H11            | D19            | C10            | D20            | User defined           |
| H10            | D21            | A9             | D22            | User defined           |
| F11            | D26            | A10            | D27            | User defined           |
| G11            | D24            | B10            | D25            | User defined           |
| D10            | D11            | D10            | D12            | Data link up active    |
| F10            | D13            | A8             | D14            | L0 state active        |
| G9             | D15            | B8             | D16            | Polling state inactive |
| G10            | D17            | C9             | D18            | PLL locked             |

### General-Purpose Header

(see Appendix A, Figure 27, J5)

A 2x9 header (J5) provides a general-purpose connection to communicate with general purpose FPGA I/Os.

**Table 13. General Purpose Header Connections**

| Header Pin | FPGA Pin | Header Pin | FPGA Pin |
|------------|----------|------------|----------|
| 1          | GND      | 2          | GND      |
| 3          | C15      | 4          | E15      |
| 5          | B15      | 6          | E14      |
| 7          | C14      | 8          | A20      |
| 9          | D14      | 10         | A19      |
| 11         | B16      | 12         | C17      |
| 13         | C16      | 14         | B17      |
| 15         | F13      | 16         | A18      |
| 17         | F14      | 18         | A17      |

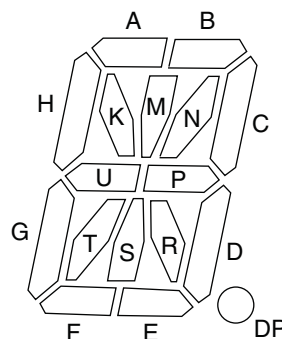
### 17-Segment LED Display

(see Appendix A, Figure 27, D13)

General-purpose FPGA pins are connected to a 17-segment display according to Table 14. These pins can be driven low to illuminate the display segments.

**Table 14. 17-Segment LED Display**

| Segment | BGA |
|---------|-----|
| A       | B7  |
| B       | F8  |
| C       | F7  |
| D       | A4  |
| E       | A3  |
| F       | H8  |
| G       | G7  |
| H       | C8  |
| K       | D8  |
| M       | B4  |
| N       | C5  |
| P       | C6  |
| R       | D6  |
| S       | C4  |
| T       | D5  |
| U       | C7  |
| DP      | B6  |



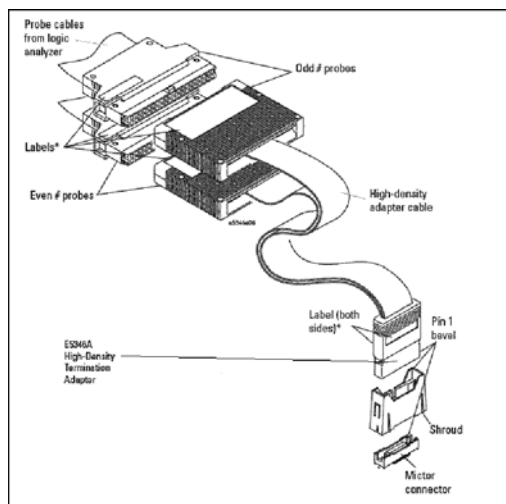
### Logic Analyzer Probe

(see Appendix A, Figure 27, LA1)

An AMP/TYCO 767004 38-position .025 VERT SMD logic analyzer probe connection is provided for the user to utilize for test points. This connection provides 34 general I/O signals to be observed on a Logic Analyzer probe using Mictor connections such as the Agilent 5346A.

**Table 15. Logic Analyzer To FPGA Pin Reference**

| Signal | FPGA Pin | Signal | FPGA Pin |
|--------|----------|--------|----------|
| LA1    | AA25     | LA2    | Y24      |
| LA3    | W23      | LA4    | W22      |
| LA5    | AA26     | LA6    | AB26     |
| LA7    | W21      | LA8    | W20      |
| LA9    | AD26     | LA10   | AD25     |
| LA11   | AA24     | LA12   | AA23     |
| LA13   | AC26     | LA14   | AC25     |
| LA15   | Y19      | LA16   | Y20      |
| LA17   | AB24     | LA18   | AC24     |
| LA19   | Y22      | LA20   | AA22     |
| LA21   | AE25     | LA22   | AF24     |
| LA23   | AD24     | LA24   | AE24     |
| LA25   | AD23     | LA26   | AC23     |
| LA27   | AB20     | LA28   | AB21     |
| LA29   | AF23     | LA30   | AE23     |
| LA31   | W17      | LA32   | AB23     |
| LA33   | AB22     | LA34   | Y21      |



### DDR2 Memory Devices

(see Appendix A, Figure 26, U14)

- The LatticeECP3 PCI Express Solutions Board is equipped with a 84-ball BGA DDR2 SDRAM memory device such as a Micron MT47H16M16BG-3 device.
- The DDR2 memory interfaces include a 16-bit wide device.
- The evaluation board includes termination of address and command signals. It includes all power and external components needed to demonstrate the memory controller of the LatticeECP3 device.

### CPLD Device

(see Appendix A, Figure 24, U12)

The board includes a Lattice Semiconductor LCMXO-1200C CPLD. This device is used in conjunction with the parallel Flash device for loading the configuration memory of the FPGA. It is also used for general-purpose board management functions. It has several connections to the FPGA and other devices on the PCB. It includes an active high, push-button (SW4) if needed for a user design.

Generic user-defined interconnections are defined in Table 16.

**Table 16. CPLD TO FPGA Interconnections**

| CPLD Pin | FPGA Pin |
|----------|----------|
| M1       | B2       |
| P13      | B3       |
| P10      | D4       |
| N7       | E4       |
| N8       | C3       |
| P11      | D3       |
| N13      | G5       |
| N1       | G6       |
| N3       | E3       |
| N4       | F4       |
| P1       | H6       |
| M12      | J6       |
| M2       | C2       |
| M3       | D2       |
| M4       | K8       |
| M6       | J7       |

## Ordering Information

| Description                                                                                   | Ordering Part Number | China RoHS Environment-Friendly Use Period (EFUP)                                     |
|-----------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------|
| LatticeECP3 PCI Express Development Kit<br>(Includes LatticeECP3 PCI Express Solutions Board) | LFE3-95EA-PCIE-DKN   |  |

## Technical Support Assistance

Hotline: 1-800-LATTICE (North America)  
+1-503-268-8001 (Outside North America)  
e-mail: [techsupport@latticesemi.com](mailto:techsupport@latticesemi.com)  
Internet: [www.latticesemi.com](http://www.latticesemi.com)

## Revision History

| Date          | Version | Change Summary                                                                                                                                                                      |
|---------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| March 2010    | 01.0    | Initial release.                                                                                                                                                                    |
| December 2010 | 01.1    | LED definitions table, L0 state changed from active to inactive.<br>Download Procedures section, changed ispVM requirement from ispVM v.17.4 (or later) to ispVM v.17.7 (or later). |
| August 2012   | 01.2    | Updated document with new corporate logo.<br>Replaced Programming schematic.                                                                                                        |

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## Appendix A. Schematic

Figure 20. Cover Page

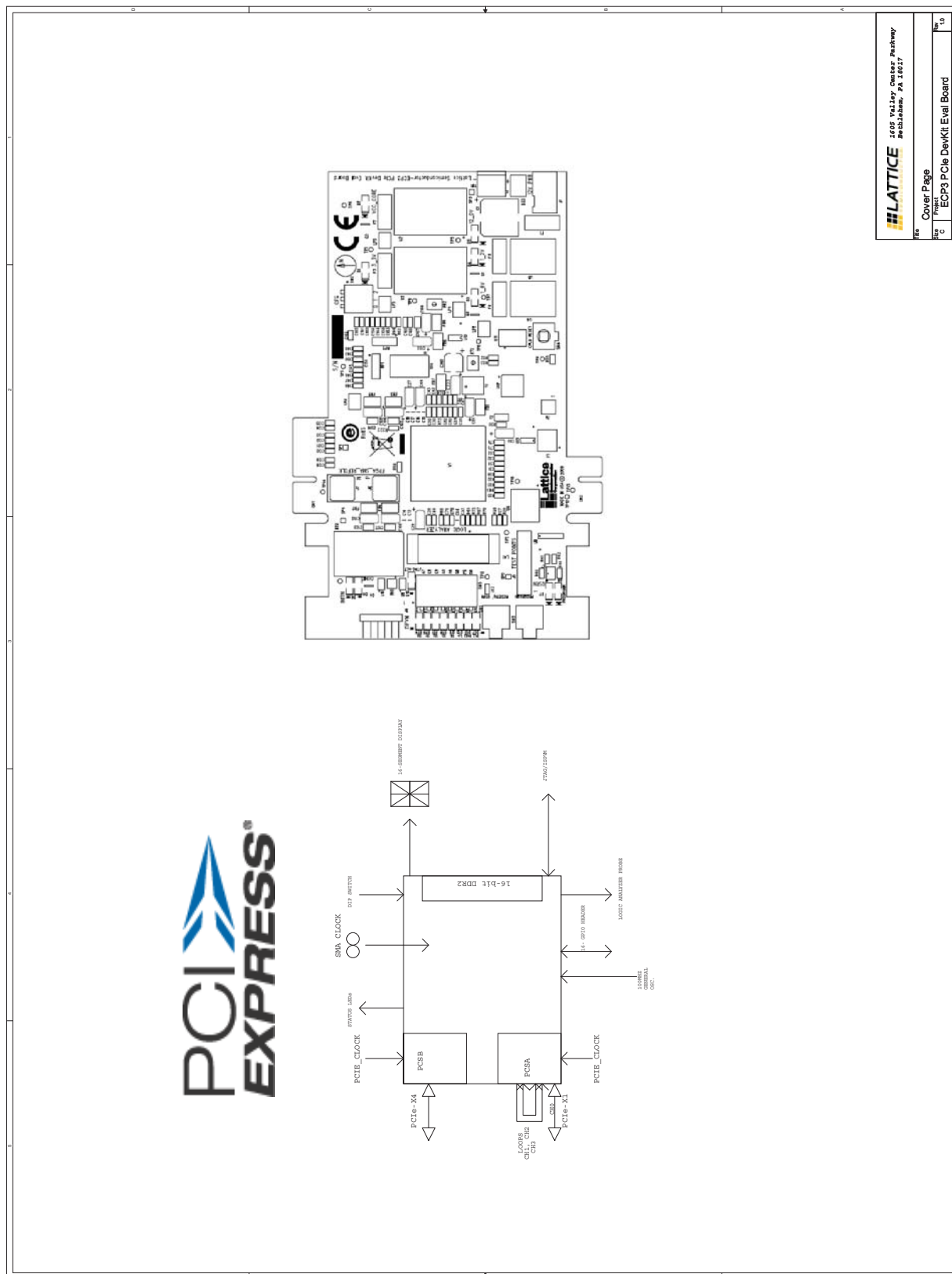




Figure 22. Power Supplies

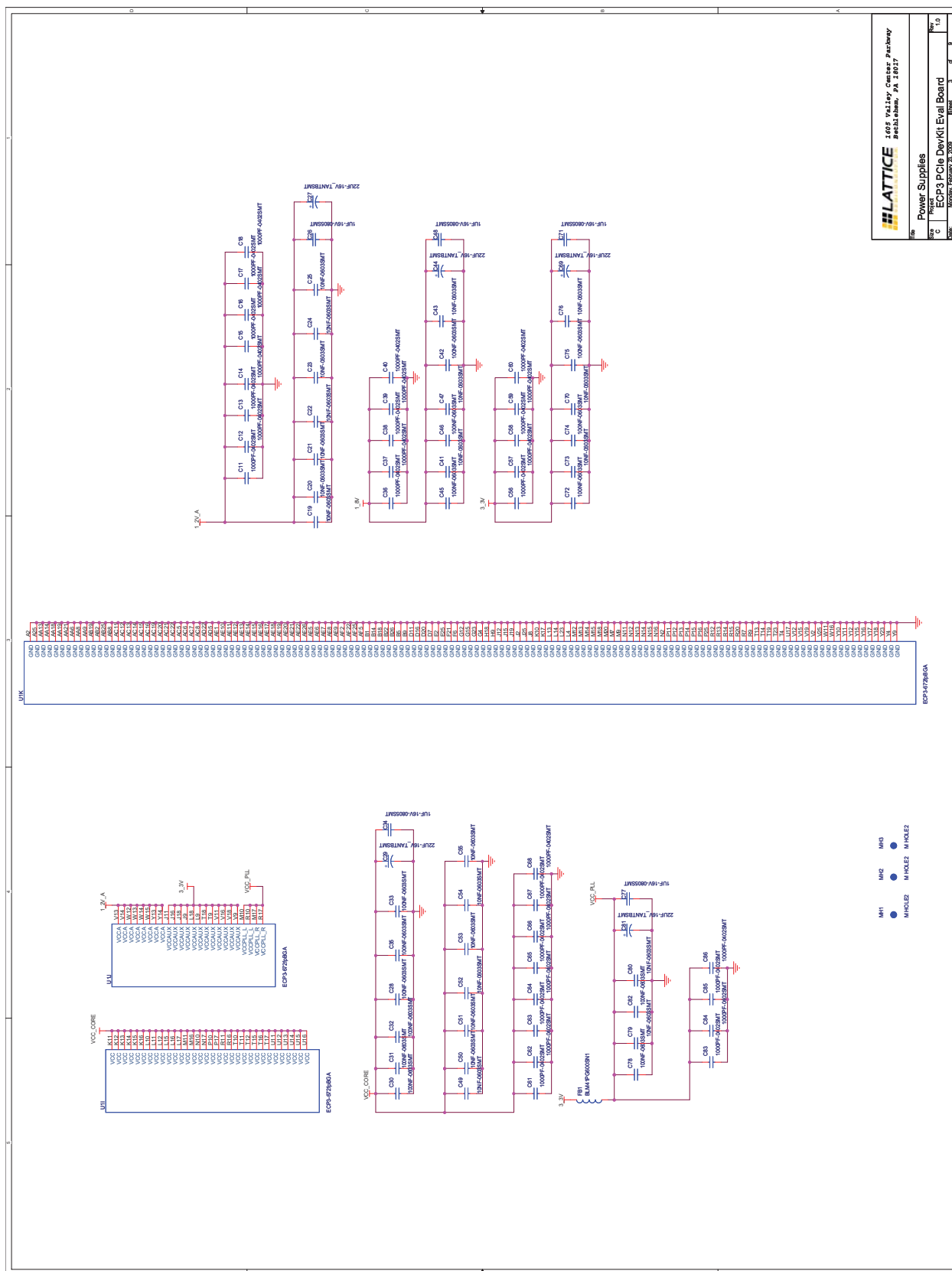
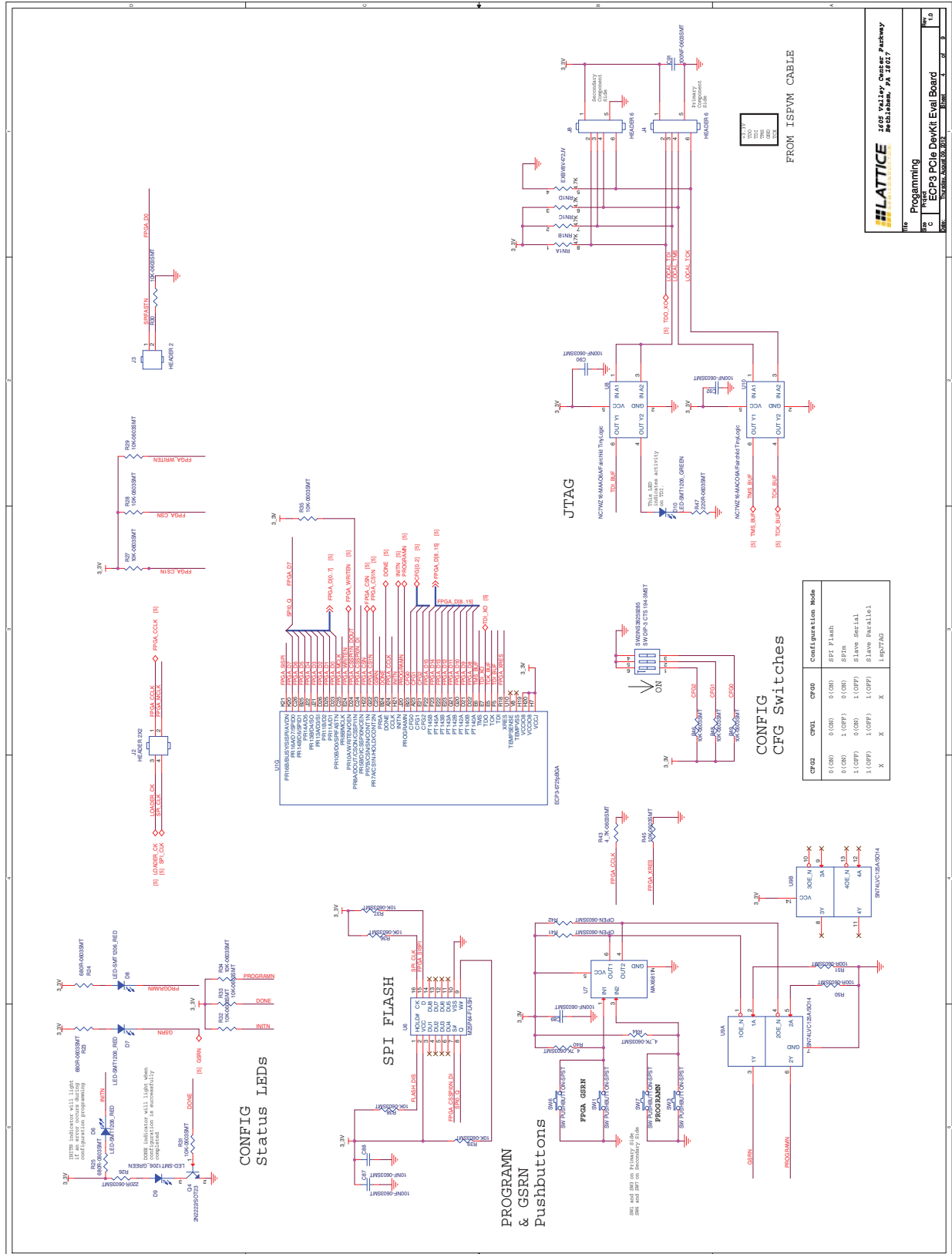
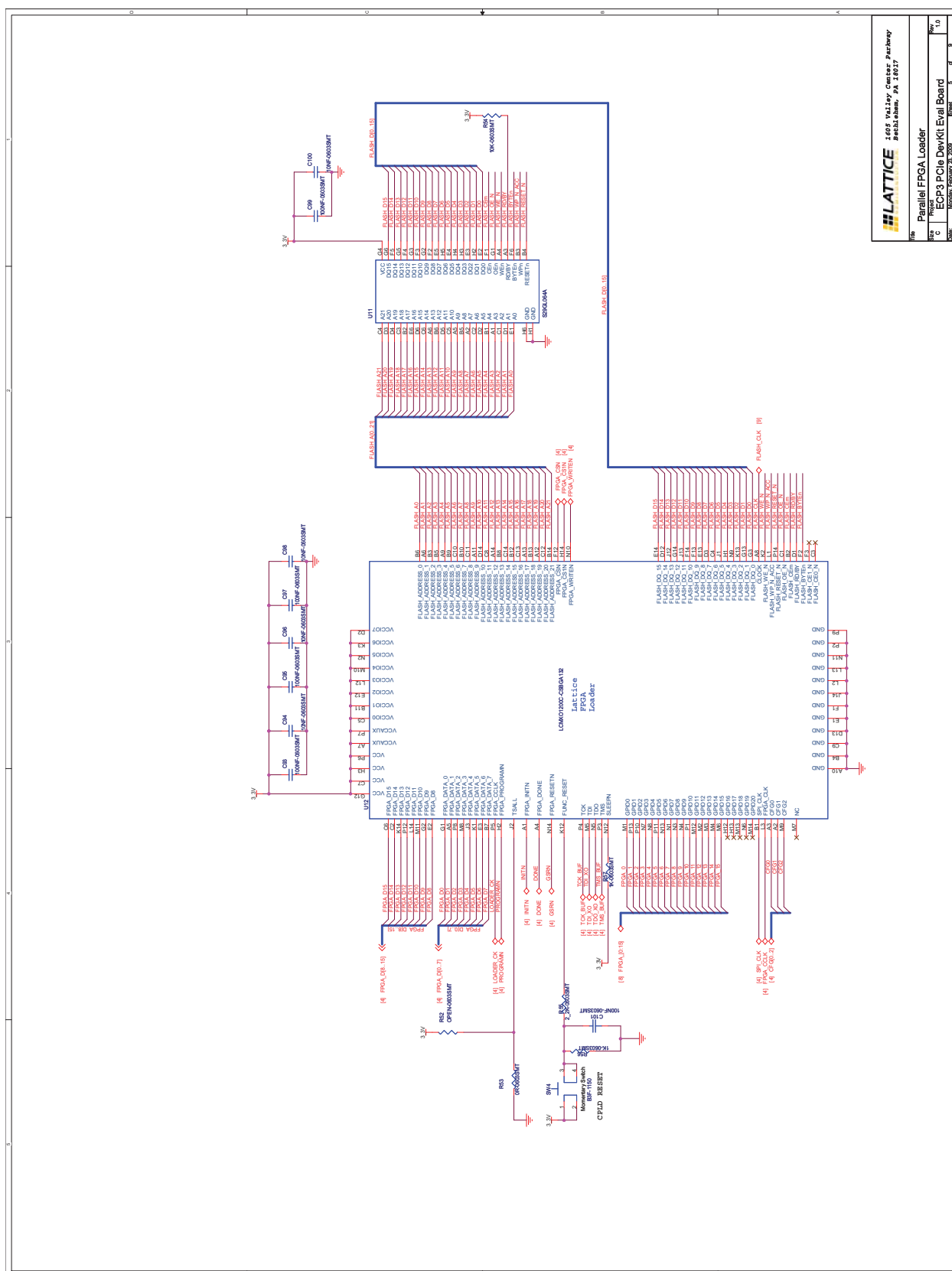


Figure 23. Programming





**Figure 25. SERDES**

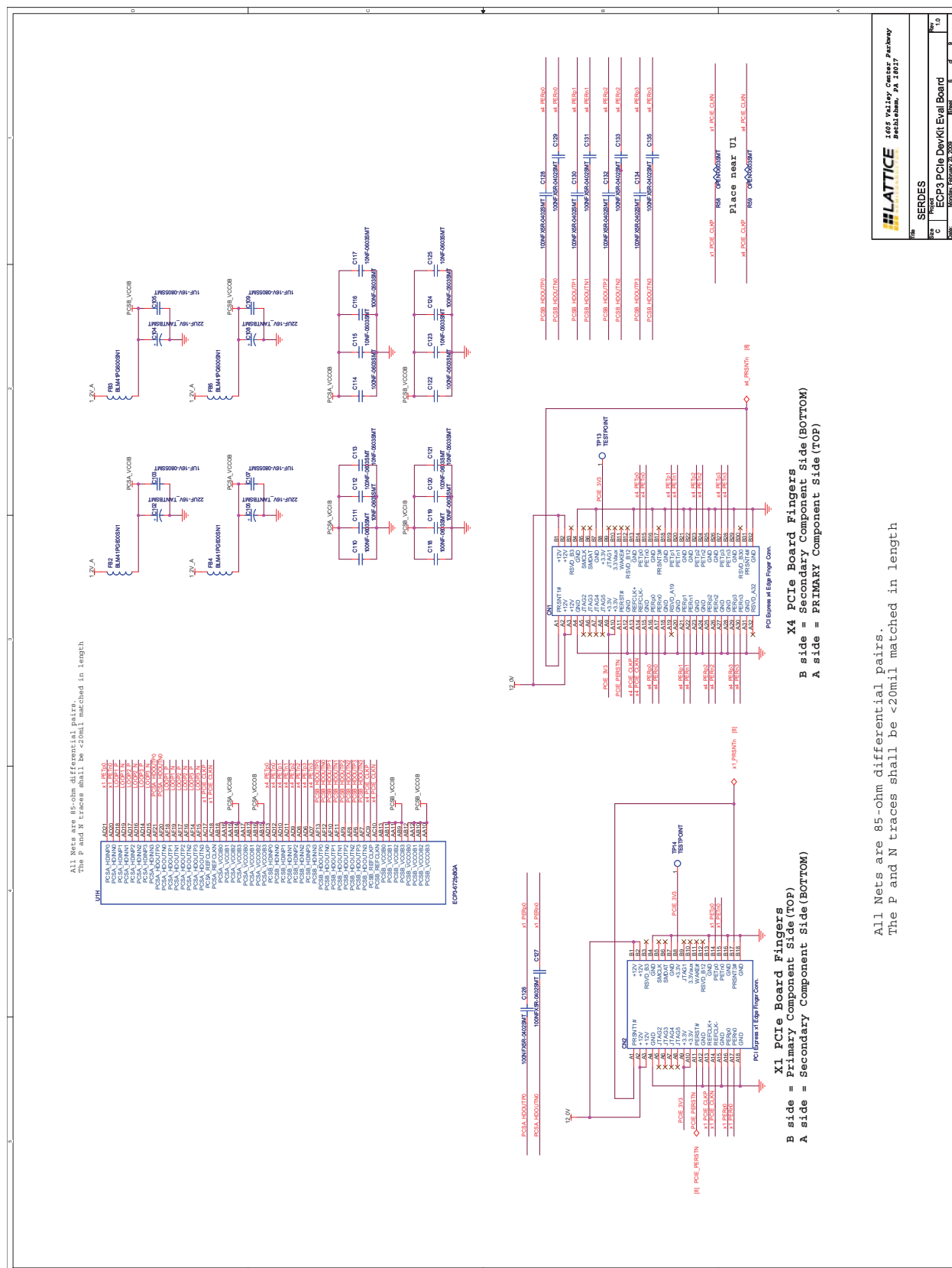
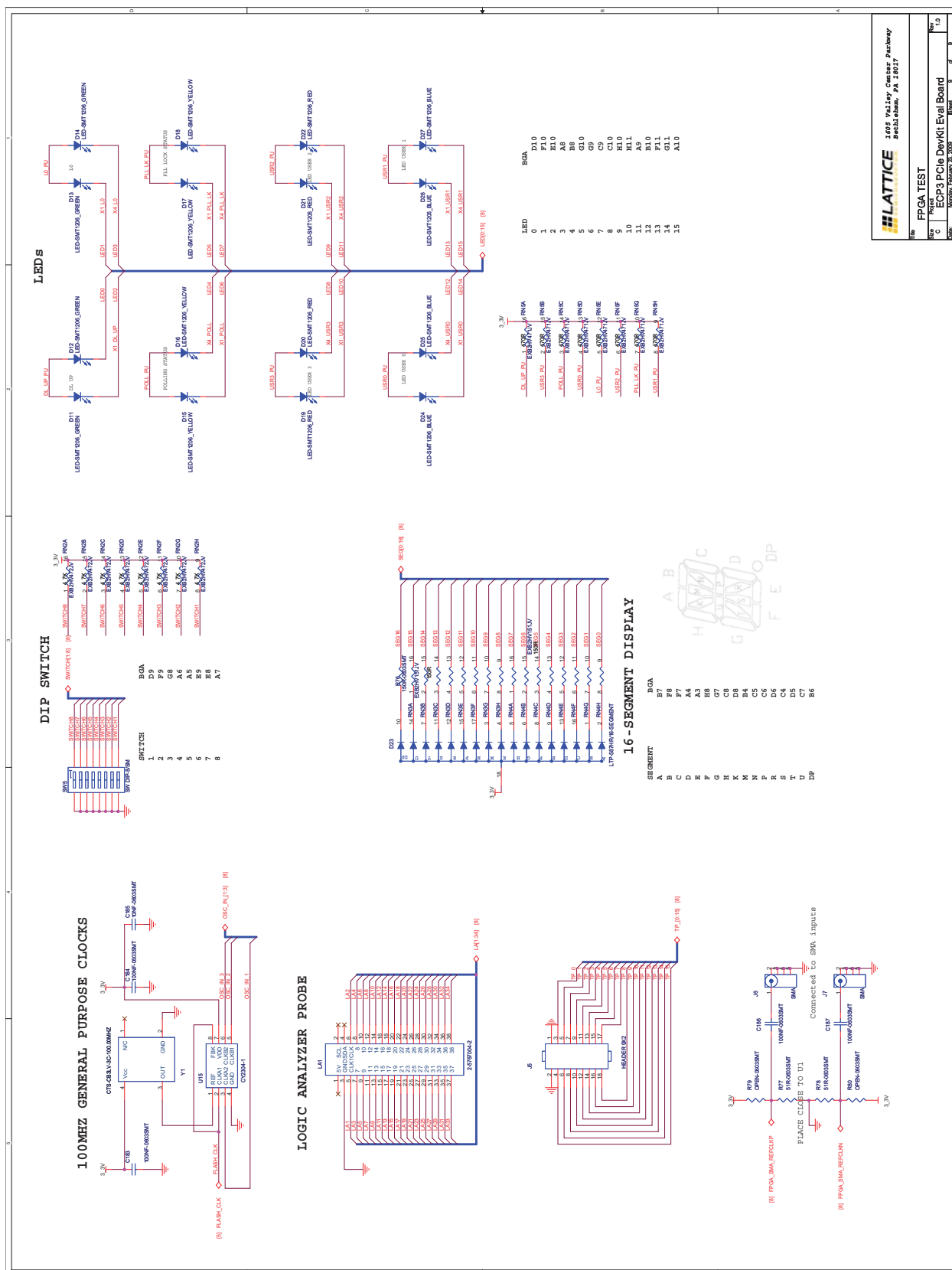






Figure 28. VSS/Decoupling



## Appendix B. Bill of Materials

Table 17. Bill of Materials

| Item | Quantity | Reference                                                                                                                                                                                                                                                                                                   | Part                             | Manufacturer | Part Number      | Description                           |
|------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------|------------------|---------------------------------------|
| 1    | 1        | CN1                                                                                                                                                                                                                                                                                                         | PCI Express x4 Edge Finger Conn. |              |                  | PCB Edge finger                       |
| 2    | 1        | CN2                                                                                                                                                                                                                                                                                                         | PCI Express x1 Edge Finger Conn. |              |                  | PCB Edge finger                       |
| 3    | 1        | C1                                                                                                                                                                                                                                                                                                          | 470UF-FKSMT                      | Panasonic    | EEV-FK1V471Q     | CAP 470UF 35V<br>ELECT FK SMD         |
| 4    | 2        | C2, C140                                                                                                                                                                                                                                                                                                    | 100UF-FKSMT                      | Panasonic    | EEEFK1V101XP     | CAP 100UF 35V<br>ELECT FK SMD         |
| 5    | 5        | C3, C4, C7, C9, C142                                                                                                                                                                                                                                                                                        | 10UF-16V-TANTBSMT                | AVX          | TAJB106K016R     | CAP 10UF 16V<br>TANT B-SIZE           |
| 6    | 4        | C5, C6, C8, C10                                                                                                                                                                                                                                                                                             | 330UF-FKSMT                      | Panasonic    | EEEFK1C331P      | CAP 330UF 16V<br>ELECT FK SMD         |
| 7    | 30       | C11, C12, C13, C14, C15, C16, C17, C18, C36, C37, C38, C39, C40, C56, C57, C58, C59, C60, C61, C62, C63, C64, C65, C66, C67, C68, C83, C84, C85, C86                                                                                                                                                        | 1000PF-0402SMT                   | Panasonic    | ECJ-0EB1E102K    | CAP 1000PF 25V<br>CERAMIC X7R<br>0402 |
| 8    | 54       | C19, C20, C21, C22, C23, C24, C25, C41, C43, C47, C49, C50, C51, C52, C53, C54, C55, C70, C73, C76, C79, C80, C88, C94, C96, C98, C100, C111, C113, C115, C117, C119, C121, C123, C125, C146, C148, C149, C150, C155, C156, C161, C162, C163, C164, C169, C170, C172, C174, C176, C178, C180, C182, C185    | 10NF-0603SMT                     | Kemet        | C0603C103K5RACTU | CAP .01UF 50V<br>CERAMIC X7R<br>0603  |
| 9    | 14       | C26, C34, C48, C71, C77, C103, C105, C107, C109, C137, C141, C144, C154, C167                                                                                                                                                                                                                               | 1UF-16V-0805SMT                  | Panasonic    | ECJ-2FB1C105K    | CAP 1UF 16V<br>CERAMIC 0805<br>X5R    |
| 10   | 12       | C27, C29, C44, C69, C81, C102, C104, C106, C108, C152, C153, C166                                                                                                                                                                                                                                           | 22UF-16V_TANTBSMT                | Kemet        | T491B226M016AT   | CAPACITOR TANT<br>22UF 16V 20%<br>SMD |
| 11   | 54       | C28, C30, C31, C32, C33, C35, C42, C45, C46, C72, C74, C75, C78, C82, C87, C89, C90, C91, C92, C93, C95, C97, C99, C101, C110, C112, C114, C116, C118, C120, C122, C124, C136, C139, C143, C145, C147, C151, C157, C158, C159, C160, C165, C168, C171, C173, C175, C177, C179, C181, C183, C184, C186, C187 | 100NF-0603SMT                    | Panasonic    | ECJ-1VF1C104Z    | CAP .1UF 16V<br>CERAMIC Y5V<br>0603   |
| 12   | 10       | C126, C127, C128, C129, C130, C131, C132, C133, C134, C135                                                                                                                                                                                                                                                  | 100NFX5R-0402SMT                 | Kemet        | C0402C104K8PACTU | CAP .10UF 10V<br>CERAMIC X5R<br>0402  |
| 13   | 1        | C138                                                                                                                                                                                                                                                                                                        | 47UF-10V-TANTBSMT                | Kemet        | T491B476M010AT   | CAPACITOR TANT<br>47UF 10V 20%<br>SMD |
| 14   | 11       | D1, D2, D3, D4, D5, D9, D10, D11, D12, D13, D14                                                                                                                                                                                                                                                             | LED-SMT1206_GREEN                | Panasonic    | LNJ316C83RA      | LED GREEN (UP)<br>W/LENS 1206         |
| 15   | 7        | D6, D7, D8, D19, D20, D21, D22                                                                                                                                                                                                                                                                              | LED-SMT1206_RED                  | Panasonic    | LNJ211R82RA      | LED RED (UP)<br>W/LENS 1206           |
| 16   | 4        | D15, D16, D17, D18                                                                                                                                                                                                                                                                                          | LED-SMT1206_YELLOW               | Panasonic    | LNJ411K84RA      | LED YELLOW (UP)<br>W/LENS 1206        |
| 17   | 1        | D23                                                                                                                                                                                                                                                                                                         | LTP-587HR/16-SEGMENT             | Lite-On      | LTP-587HR        | 16-segment array                      |
| 18   | 4        | D24, D25, D26, D27                                                                                                                                                                                                                                                                                          | LED-SMT1206_BLUE                 | Panasonic    | LNJ916C8BRA      | LED BLUE (UP)<br>W/LENS 1206          |
| 19   | 8        | FB1, FB2, FB3, FB4, FB5, FB6, FB7, FB8                                                                                                                                                                                                                                                                      | BLM41PG600SN1                    | Murata       | BLM41PG600SN1L   | FERRITE CHIP 60<br>OHM 6000MA 1806    |
| 20   | 5        | F1, F2, F3, F4, F5                                                                                                                                                                                                                                                                                          | F1228CT-ND                       | Littlefuse   | 0154005.DR       | FUSEBLOCK WITH<br>5A FUSE SMD         |
| 21   | 1        | J1                                                                                                                                                                                                                                                                                                          | 22HP037-2.1mm                    | Condor       | 22HP037-2.1mm    | power input                           |
| 22   | 1        | J2                                                                                                                                                                                                                                                                                                          | HEADER 2X2                       | Samtec       | TSW-102-07-T-D   | 2x2-0.25 Header                       |
| 23   | 1        | J3                                                                                                                                                                                                                                                                                                          | HEADER 2                         | Samtec       | TSW-102-07-T-S   | 2x1-0.25 Header                       |
| 24   | 2        | J4, J8                                                                                                                                                                                                                                                                                                      | HEADER 6                         | Samtec       | TSM-106-01-T-SH  | 6x1-0.25 Header-SMT                   |
| 25   | 1        | J5                                                                                                                                                                                                                                                                                                          | HEADER 9X2                       | Samtec       | TSW-109-07-T-D   | 9x2-0.25 Header                       |

**Table 17. Bill of Materials (Continued)**

| Item | Quantity | Reference                                                  | Part          | Manufacturer                                | Part Number       | Description                      |
|------|----------|------------------------------------------------------------|---------------|---------------------------------------------|-------------------|----------------------------------|
| 26   | 2        | J6, J7                                                     | SMA           | Molex                                       | 73391-0060        | CONN JACK SMA STR 50 OHM PCB     |
| 27   | 1        | LA1                                                        | 2_5767004-2   | Amp                                         | 2_5767004-2       | CONN RECEPT 38POS .025 VERT SMD  |
| 28   | 5        | LP1, LP2, LP3, LP4, LP5                                    | 5016          | Keystone Electronics                        | 5016              | TEST POINT PC COMPACT SMT        |
| 29   | 3        | MH1, MH2, MH3                                              | M HOLE2       |                                             |                   |                                  |
| 30   | 2        | PP1, PP2                                                   | PROBEPOINT    |                                             |                   |                                  |
| 31   | 4        | Q1, Q2, Q3, Q4                                             | 2N2222/SOT23  | Diodes Inc.                                 | MMBT2222A-7-F     | TRANS NPN 40V 350MW SMD SOT-23   |
| 32   | 1        | RN1                                                        | EXBV8V472JV   | Panasonic                                   | EXBV8V472JV       | RES ARRAY 4.7K OHM 5% 4 RES SMD  |
| 33   | 1        | RN2                                                        | EXB2HV472JV   | Panasonic                                   | EXB2HV472JV       | RES ARRAY 4.7K OHM 5% 8 RES SMD  |
| 34   | 2        | RN3, RN4                                                   | EXB2HV151JV   | Panasonic                                   | EXB2HV151JV       | RES ARRAY 150 OHM 5% 8 RES SMD   |
| 35   | 1        | RN5                                                        | EXB2HV471JV   | Panasonic                                   | EXB2HV471JV       | RES ARRAY 470 OHM 5% 8 RES SMD   |
| 36   | 2        | RP1, RP2                                                   | CTS-R2402B7   | CTS Corporation Resistor/ Electrocomponents | CTS-R2402B7TR7    | RES NET DDR SDRAM 50 OHM 3X9 BGA |
| 37   | 4        | R1, R2, R3, R4                                             | 1_8K-1206SMT  | Panasonic                                   | ERJ-8GEYJ182V     | RES 1.8K OHM 1/4W 5% 1206 SMD    |
| 38   | 1        | R76                                                        | 150R-0603SMT  | Panasonic                                   | ERA-3YEB151V      | RES 150 OHM 1/16W .1% 0603 SMD   |
| 39   | 23       | R6, R7, R8, R21, R22, R27, R28, R29, R30, R31, R32         | 10K-0603SMT   | Panasonic                                   | ERJ-3GEYJ103V     | RES 10K OHM 1/10W 5% 0603 SMD    |
|      |          | R33, R34, R35, R36, R37, R38, R39, R45, R46, R48, R49, R54 |               |                                             |                   |                                  |
| 40   | 7        | R9, R10, R53, R64, R67, R73, R75                           | 0R-0603SMT    | Panasonic                                   | ERJ-3GEY0R00V     | RES ZERO OHM 1/10W 5% 0603 SMD   |
| 41   | 2        | R11, R12                                                   | OPEN-0805SMT  |                                             |                   |                                  |
| 42   | 1        | R13                                                        | 12_1K-0603SMT | Susumu Co Ltd.                              | RG1608P-1212-B-T5 | RES 12.1K OHM 1/10W .1% 0603 SMD |
| 43   | 2        | R14, R20                                                   | 2K-0603SMT    | Panasonic                                   | ERJ-3EKF2001V     | RES 2.00K OHM 1/10W 1% 0603 SMD  |
| 44   | 2        | R15, R16                                                   | 100R-0805SMT  | Panasonic                                   | ERJ-6GEYJ101V     | RES 100 OHM 1/8W 5% 0805 SMD     |
| 45   | 8        | R17, R19, R56, R57, R61, R66, R68, R74                     | 1K-0603SMT    | Panasonic                                   | ERJ-3EKF1001V     | RES 1.00K OHM 1/16W 1% 0603 SMD  |
| 46   | 1        | R18                                                        | 806R-0603SMT  | Panasonic                                   | ERJ-3EKF8060V     | RES 806 OHM 1/10W 1% 0603 SMD    |
| 47   | 3        | R23, R24, R25                                              | 680R-0603SMT  | Panasonic                                   | ERJ-3GEYJ681V     | RES 680 OHM 1/10W 5% 0603 SMD    |
| 48   | 3        | R5, R26, R47                                               | 220R-0603SMT  | Panasonic                                   | ERJ-3GEYJ221V     | RES 220 OHM 1/10W 5% 0603 SMD    |
| 49   | 7        | R40, R43, R44, R60, R69, R70, R71                          | 4_7K-0603SMT  | Panasonic                                   | ERJ-3GEYJ472V     | RES 4.7K OHM 1/10W 5% 0603 SMD   |
| 50   | 8        | R41, R42, R52, R58, R59, R63, R79, R80                     | OPEN-0603SMT  |                                             |                   |                                  |
| 51   | 2        | R50, R51                                                   | 100R-0603SMT  | Panasonic                                   | ERA-3YEB101V      | RES 100 OHM 1/16W .1% 0603 SMD   |

**Table 17. Bill of Materials (Continued)**

| Item | Quantity | Reference                                         | Part                               | Manufacturer                               | Part Number         | Description                                               |
|------|----------|---------------------------------------------------|------------------------------------|--------------------------------------------|---------------------|-----------------------------------------------------------|
| 52   | 1        | R55                                               | 2_2K-0603SMT                       | Panasonic                                  | ERJ-3GEYJ222V       | RES 2.2K OHM<br>1/10W 5% 0603<br>SMD                      |
| 53   | 2        | R62, R72                                          | 1K_ADJ/SMT3MM                      | Murata                                     | PVG3A102C01R00      | POT 1K 3MM<br>CERM SQ S/T SMD                             |
| 54   | 0        | R65(deleted)                                      | 0R-2010SMT                         | Vishay/Dale                                | CRCW20100000Z0EF    | RES 0.0 OHM1/2W<br>5% 2010 SMD                            |
| 55   | 2        | R77, R78                                          | 51R-0603SMT                        | Panasonic                                  | ERJ-3GEYJ510V       | RES 51 OHM<br>1/10W 5% 0603<br>SMD                        |
| 56   | 4        | SP1, SP2, SP3, SP4                                | TEST POINT                         |                                            |                     |                                                           |
| 57   | 4        | SW1, SW3, SW6, SW7                                | SW PUSHBUTTON-SPST                 | C&K Components                             | EP11FPD1SAPE        | SPST- Momentary<br>RA/SMT                                 |
| 58   | 1        | SW2                                               | SW DIP-3 CTS 194-3MST              | CTS Corporation Resistor/Electrocomponents | 194-3MST            | SWITCH SIDE<br>ACTUATED GOLD<br>3 SEC                     |
| 59   | 1        | SW4                                               | B3F-1150                           | Omron                                      | B3F-1150            | SWITCH TACT<br>6MM 100GF<br>H=7.3MM                       |
| 60   | 1        | SW5                                               | SW DIP-8/SM                        | C&K Components                             | BPA08SB             | 8-POSITION DIP<br>PACK                                    |
| 61   | 1        | TB1                                               | Terminal Block/ED1202DS            | On-Shore Tech.                             | ED120/2DS           | TERMINAL BLOCK<br>5.08MM VERT<br>2POS                     |
| 62   | 14       | TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10 | TESTPOINT                          |                                            |                     |                                                           |
|      |          | TP11, TP12, TP13, TP14                            |                                    |                                            |                     |                                                           |
| 63   | 1        | U1                                                | ECP3-672fpBGA                      | LATTICE SUPPLIED                           |                     |                                                           |
| 64   | 1        | U2                                                | PTH12060L                          | Texas Instruments                          | PTH12060LAH         | MODULE PIP<br>12VIN 10A ADJ 10-<br>TH                     |
| 65   | 1        | U3                                                | PTH12060W                          | Texas Instruments                          | PTH12060WAH         | MODULE PIP<br>12VIN 10A ADJ 10-<br>TH                     |
| 66   | 2        | U4, U5                                            | SC1592                             | Semtech                                    | SC1592IMTRT         | IC LDO ADJ REG<br>3A TO-263-7                             |
| 67   | 1        | U6                                                | M25P64-FLASH                       | STMicro                                    | M25P64-VMF6P        | IC SRL FLASH<br>64MBIT 3V 16-SOP<br>Wide(300MIL)          |
| 68   | 1        | U7                                                | MAX6817                            | Maxim                                      | MAX6817-EUT+T       | ±15kV ESD-Pro-<br>tected, Dual, CMOS<br>Switch Debouncers |
| 69   | 2        | U8,U10                                            | NC7WZ16-MAAO6A/Fairchild TinyLogic | Fairchild                                  | NC7WZ16P6X          | IC BUFFER UHS<br>DUAL SC70-6                              |
| 70   | 1        | U9                                                | SN74LVC125A/SO14                   | Texas Instruments                          | SN74LVC125AD        | IC QUAD BUS BUF-<br>FER GATE 14-SOIC                      |
| 71   | 1        | U11                                               | S29GL064A                          | Spansion                                   | S29GL064N90BF1040   | 48fBGA FLASH-<br>VBN048                                   |
| 72   | 1        | U12                                               | LCMXO1200C-CSBGA132                | LATTICE SUPPLIED                           |                     |                                                           |
| 73   | 1        | U13                                               | LP2998-SO8                         | National Semi                              | LP2998MA/NOPB       | IC DDR TERMINA-<br>TION REG 8SOIC                         |
| 74   | 1        | U14                                               | DDR2-SDRAM-84FBGA                  | Micron                                     | MT47H16M16BG-37E    | 16-Bit DDR2                                               |
| 75   | 1        | U15                                               | CY2304-1                           | Cypress Semiconductor                      | CY2304SXC-1         | zero delay buffer                                         |
| 76   | 1        | Y1                                                | CTS-CB3LV-3C-100.00MHZ             | CTS-Frequency Controls                     | CB3LV-3I-100M0000-T | OSC CLOCK<br>100,000 MHZ 3.3V<br>SMD                      |
| 77   | 1        | Bracket                                           |                                    |                                            |                     |                                                           |
| 78   | 2        | Screw                                             | 4-40 x .250                        |                                            |                     |                                                           |
| 79   | 2        | Flat washer                                       | 4-40                               |                                            |                     |                                                           |
| 80   | 2        | Lock washer                                       | 4-40                               |                                            |                     |                                                           |
| 81   | 2        | C222, C224                                        | 100NF-0603SMT                      | Panasonic                                  | ECJ-1VF1C104Z       | CAP .1UF 16V<br>CERAMIC Y5V<br>0603                       |
| 82   | 1        | C223                                              | 10UF-16V-TANTBSMT                  | AVX                                        | TAJB106K016R        | CAP 10UF 16V<br>TANT B-SIZE                               |

**Table 17. Bill of Materials (Continued)**

| Item | Quantity | Reference              | Part                  | Manufacturer | Part Number         | Description                         |
|------|----------|------------------------|-----------------------|--------------|---------------------|-------------------------------------|
| 83   | 1        | R227                   | 1_6R-0603SMT          | Panasonic    | ERJ-3GEYJ1R6V       | RESISTOR 1.6 OHM 1/10W 5% 0603      |
| 84   | 4        | R223, R224, R228, R229 | 50R-0402SMT           | Vishay       | FC0402E50R0BTBST1   | RES 50 OHM 50MW .1% 0402 SMD        |
| 85   | 1        | Y2                     | CRYSTEK_133MHZ        | Crystek      | CCLD-033-50-133.000 | OSC LVDS 133.0 MHZ 3.3V 7mmx5mm SMD |
| 86   | 2        | C220, C225             | 10NF-0402SMT          | Panasonic    | ECJ0EB1E103K        | CAP .01UF 25V CERAMIC X7R 0402      |
| 87   | 1        | R222                   | 50R-0603SMT           | Vishay       | FC0603E50R0BTBT1    | RES 50 OHM 125MW .1% 0603 SMD       |
| 88   | 1        | D33                    | SCHOTTKY/VISHAYV12P10 | Vishay       | V12P10-E3/87A       | TO277 SCHOTTKY DIODE                |



**Стандарт  
Электрон  
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331