600-2708
PCI EXPRESS EXPANSION SYSTEM
USER'S MANUAL

Revision 1.0, June 2010

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

The Cyclone Microsystems 2708 PCI Express Gen2 Expansion System is a PCI Express (PCIe) expansion system that allows the user to add up to eight PCI Express add-in-cards. Most PCs contain few PCI Express slots making them poorly suited for embedded systems requiring many different I/O boards and co-processor resources.

The 2708 PCI Express Expansion System permits system developers to use powerful and cost-effective PCs as a foundation for a robust embedded system. The eight PCI Express slots are organized as x1 slots with x4 connectors and are all Gen2 capable. Note when installed in a standard Cyclone rack mounted chassis, only seven of the eight slots are available. A 680 watt supply powers the rack mounted expansion chassis and is cooled by one 120 CFM and two 59 CFM fans.

The Expansion System supports 40 Gb/s bi-directional traffic to and from the host system. The system utilizes repeaters and non-blocking PCI Express switches for excellent peer-to-peer I/O bandwidth. For PCs with modern BIOSs, the 2708 Expansion System is recognized by the host system upon boot-up, requires no hardware specific drivers and is entirely host operating system agnostic.

The 600-2708 system is composed of three elements: a PCI Express Host Bus Cable Adapter, an Expansion System Cable and an Expansion Chassis. The PCIe-425 Host Bus Cable Adapter card is to be inserted into a host computer's x8 PCIe Gen2 slot. The x8 PCIe expansion cable links the PCI host with the expansion chassis. The expansion chassis is populated with the PCIe-451 Switched Backplane.

PCI Express is a high performance, general purpose I/O inter-connect defined for a wide variety of computing and communication platforms. Key PCI attributes, such as its usage model, load-store architecture, and software interfaces are maintained, whereas its parallel bus implementation is replaced by a serial interface. PCI Express take advantage of recent advances in point-to-point inter-connects, Switch-based technology, and packetized protocol to deliver new levels of performance.

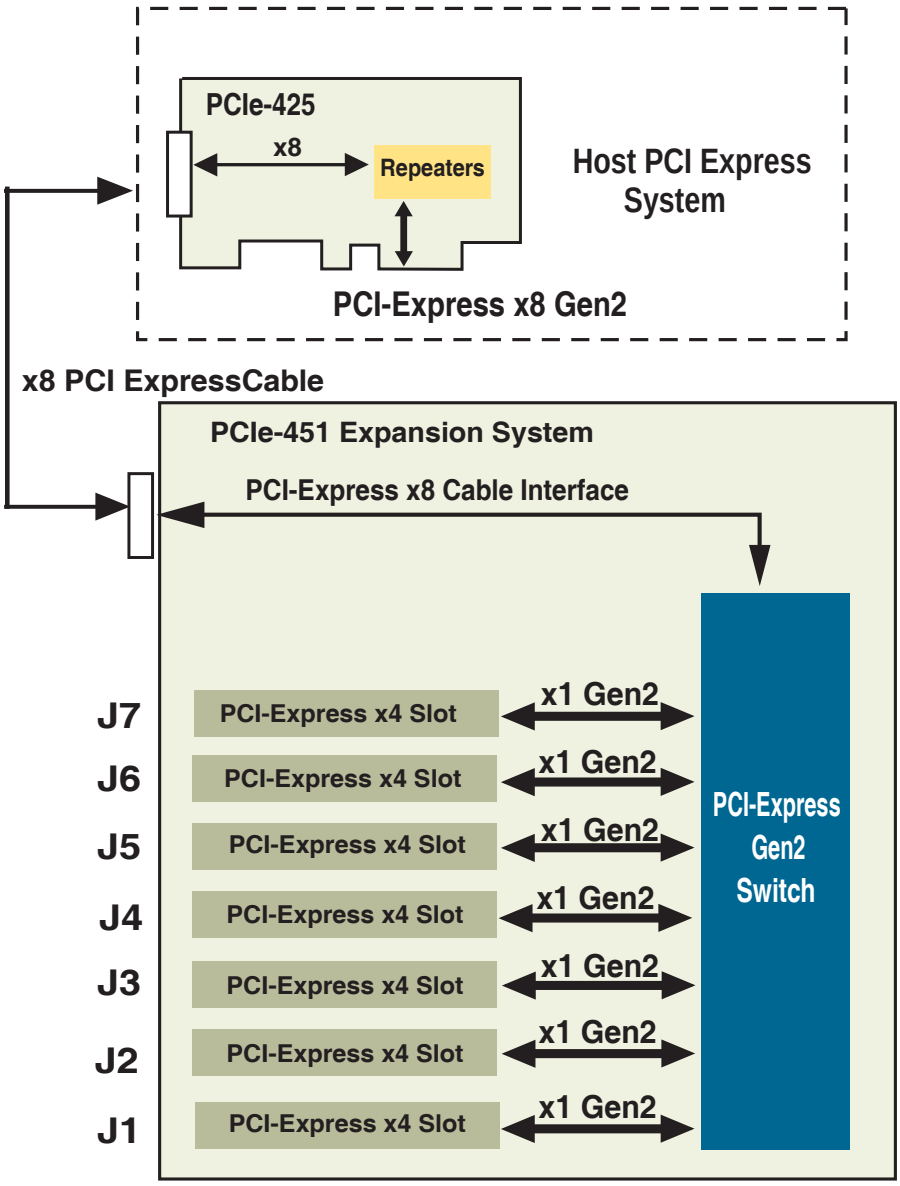

Figure 1-1. 600-2708 Block Diagram

1.2 SPECIFICATIONS

The specifications in Table 1-1 detail the 600-2708 Expansion System chassis including the PCIe-451 expansion backplane and the 680W power supply. The chassis also includes one 120 CFM and two 59 CFM fans.

Table 1-1. Specifications

Physical	Height	7 inches
	Width	17 inches
	Depth	22 inches
	Other	19 inch rack mountable
Electrical	Voltage	115/230 VAC
	Frequency	60Hz/50Hz.
	Input Current	10 A for 115 VAC, 5.0 A for 230 VAC.
	Inrush Current	60 A max. for 115 VAC
Environmental	Operating Temperature	0 to 50 Degrees Celsius
	Relative Humidity	0% to 95% (non-condensing)
	Storage Temperature	-20 to 70 Degrees Celsius

1.3 STANDARDS

PCI Express Base Specification Revision 2.0

PCI Express Card Electro Mechanical Specification 2.0

PCI Express External Cabling Specification 2.0

1.4 ORDERING INFORMATION

The expansion system is avaliable with one or three meter cables and standard or low profile panels on the Host Bus Adaptor (PCIe-425).

Cyclone Part Numbers	
600-2708-3-SH	Expansion System with 3 meter cable and standard height panel
600-2708-1-SH	Expansion System with 1 meter cable and standard height panel
600-2708-3-LP	Expansion System with 3 meter cable and low profile panel
600-2708-1-LP	Expansion System with 1 meter cable and low profile panel

CHAPTER 2
THEORY OF OPERATION

2.1 THEORY OF OPERATION

The basic PCI Express link consists of dual unidirectional differential links, implemented as a transmit pair and a receive pair. The signaling rate for PCI Express Gen1 is 2.5 Gigabits/second/Lane/direction and Gen2 is 5.0 Gigabits/second/Lane/direction. A link supports at least one lane.

The PCIe-425 is installed in a x8, Gen1 or Gen2 host slot. The PCI Express link from the PCIe-425 over the cable to the PCIe-451 is an eight lane (x8) Gen2 link. The PCIe-451 provides eight x1 slots so bandwidth is matched back to the host slot. All PCIe-451 slots are populated mechanically with x4 connectors; the upper three lanes of the slots are not connected. Although not expressly permitted by the PCI Express Specification, the slots will accommodate “down-shifting” a x4 card into a x1 slot. Plugging a smaller link card into a larger link connector is fully allowed.

Once the PCIe-425 is installed into the host PC, the cable connected to the PCIe-451, the chassis plugged into an AC power outlet and any desired add-in cards are installed, the system is ready to be turned on. When the host is turned on, a signal from the PCIe-425 will turn on the PCIe-451 chassis. A number of things happen at this point. First, the PCI Express links are initialized. This is a purely hardware initialization where each PCI Express link is set up following a negotiation of lane widths by the two ends of each link. No firmware or operating system software is involved. Once the links are initialized or “trained”, there are LED indicators on each of the Cyclone Microsystems cards that indicate the links are trained. A detailed explanation of the LEDs follows later in this manual.

One essential requirement for system initialization is the ability of the host system’s BIOS to be able to enumerate the many bridges inherent in a complex PCI Express design. The links from the PCIe-425 to the PCIe-451 are created with PCI Express Switches. Each link looks like a PCI-to-PCI bridge to the Host’s BIOS. The number of bridges can add up quickly. Older BIOS may not have the resources to enumerate the number of bridges. Make sure that the BIOS on the host computer has the latest updated BIOS. If required, contact the host system’s manufacturer to make sure that the BIOS used can handle the large number of bridges that it will see in the system.

CHAPTER 3
EXPANSION CHASSIS

3.1 600-2708 CHASSIS

The PCIe-451 Expansion Backplane is installed into a seven slot rack mountable chassis. The chassis provides access to seven of the eight PCI Express slots. All slots can accommodate standard height and full length PCI Express add-in cards. The chassis also contains three drive bays that may be used to install peripheral devices for specific applications. There are several four pin peripheral power connectors, floppy drive connectors and SerialATA connectors available from the power supply.

3.2 SEATING OF CARDS

Unlike standard PC applications, the 2708 Expansion System has a narrow lower gate that precisely engages the lower end of the PCI Express Add-In board's face panel. The purpose is to ensure correct electrical connector mating of up-plugged boards. Failure to accurately mate the lower end of the face panel with the chassis lower gate will lead to the board not being recognized by the host.

All eight slots of the PCIe-451 have x4 connectors. There is only a x1 lane connection from each slot to the switch.

3.3 CHASSIS COOLING

Airflow in the 600-2708 chassis is provided by one 120 CFM fan located at the front of the chassis and two 59 CFM fans located at the rear of the chassis.

3.4 CHASSIS POWER

The chassis contains a 680W ATX12V power supply with two independent 12V outputs, however only +12-V1 is used by the PCIe-451. The PCIe-451 can support 25W of +12V power at all eight slots. Assuming the cards also draw the maximum 10W from +3.3V, then a fully populated chassis would have about 370W surplus power available for peripheral components. .

3.5 POWER CONSIDERATIONS

Table 3-1 through 3-3 show the power consumption for the Cyclone Microsystems boards and the power supplied to PCI Express slots. Note that the PCIe-425 is installed in and powered by the host supply. Consequently, the PCIe-425 should not be included as a component of the Expansion Chassis power budget.

Table 3-1. PCIe- 451 Power Requirements

Voltage	Current Minimum	Current Typical	Current Maximum	Where Used
+3.3V	0.300 Amps	1.2 Amps	(24 + 1.2) Amps*	Slots J1-J8 and baseboard
+5V	0.100 Amps**	0.100 Amps	0.100 Amps	Not used
+12V-1	0.00 Amps	0.00 Amps	16.8 Amps***	Slots J1- J8 only
+12V-2	0.00 Amps	0.00 Amps	0.00 Amps	Not used
-12V	0.00 Amps	0.00 Amps	0.00 Amps	Not used
-5V	0.00 Amps	0.00 Amps	0.00 Amps	Not used
+5VSB	0.00 Amps	0.00 Amps	0.00 Amps	Not used

The chassis contains a 680W ATX12V power supply with two independent 12V outputs, however only +12-V1 is used by the PCIe-451. The PCIe-451 can support 25W of +12V power at all eight slots. Assuming the cards also draw the maximum 10W from +3.3V, then a fully populated chassis would have about 370W surplus power available for peripheral components.

Table 3-2. PCIe- 425 Power Requirements

Voltage	Current Typical	Current Maximum
+3.3V	0.62 Amps	0.87 Amps
+12V	0 Amps	0 Amps

* The PCIe-425 does not use +12V

Table 3-3. Power Supplied Per PCIe Slot

Voltage	Current Maximum	Voltage Tolerance
+3.3V	3.0 Amps	+/- 9%
+12V	2.1 Amps	+/- 8%

3.6 PCI-E AUXILARY POWER CONNECTORS

Some PCIe add-in cards require more power than the PCIe slot connector can provide. These cards will have a six position, two row by three column, Molex type power connector probably located at the top or rear edge of the card. The power supply in the expansion chassis has two PCIe auxilary power cables available for these card types.

CHAPTER 4
SYSTEM OPERATION

4.1 SYSTEM POWER UP

The host PC with the PCIe-425 installed controls power-up for the entire system. The PCI Express cable should be connected between the PCIe-425 and the PCIe-451 and the 600-2708 power cord should be connected to the chassis and plugged into a power socket. There is a power button on the front of the 600-2708 Expansion Chassis, however, it is not connected and serves no practical purpose in this application. When the host PC is powered on, a signal is sent over the PCI Express cable to turn on the 600-2708. If the chassis does not power up, make sure that all cards are seated properly, the chassis is plugged in, the PCI Express cable is connected properly and the switch on the power supply is in the on ("1") position.

4.2 SEATING OF CARDS

Unlike standard PC applications, the 2708 Expansion Systems has a narrow lower gate that precisely engages the lower end of the PCI Express Add-In board's face panel. The purpose is to ensure correct electrical connector mating of up-plugged boards. Failure to accurately mate the lower end of the face panel with the chassis lower gate will lead to the board not being recognized by the host.

4.3 PCIe-425 HOST BUS CABLE ADAPTER

The PCIe-425 Host Bus Cable Adapter is installed in a host computer's x8 Gen2 slot providing a bandwidth matched interface from the host to the x8 cable and, in turn, the expansion chassis. It can also be plugged into Gen1 x8 slots, reducing performance.

4.3.1 PCIe-425 Power

The PCIe-425 only uses +3.3V power from the host, see Table 3-2.

4.3.2 PCIe-425 Mechanical

The PCIe-425 is a low profile PCI Express add-in card and is available with either a standard height front panel or a low profile front panel. See Figure 5-3 for a mechanical drawing of the card and Figure 5-2 for a front panel drawing.

4.3.3 PCIe-425 LED Indicators

The bottom (or left) LED on the front panel is the "Cable Present Detect" LED. This green LED reflects the status of the "CPRSNT#" signal in the PCIe Expansion Cable. When the LED is ON, it is indicating that the "CPRSNT#" signal is asserted. The PCIe-451 chassis asserts "CPRSNT#" to indicate that it is present, the cable is connected and power is good. If this LED is OFF, there may be a problem with +3.3V power in the expansion chassis or the PCIe Expansion Cable is not connected properly.

The top (or right) LED on the panel is "Expansion System Signal Detect". The LED is on when the PCIe-425 detects a signal on Lanes 0-3 of the PCIe cable. The LED ON indicates normal operation. If the LED is not on, there is something wrong with the cable or the expansion system is not operating properly.

4.3.4 PCIe-425 Output Swing, De-Emphasis and Receive Equalization

The transceiver silicon used on the PCIe-425 has eight steps of programmable de-emphasis, four steps of output swing and eight steps of receive equalization. The PCIe-425 has three DIP switches to adjust these settings on the cable interface. The as-shipped-default DIP switch configuration is what Cyclone Microsystems has determined is the best setting for Gen2 operation with both the 1m and 3m PCIe cables shipped with Cyclone PCIe Expansion systems. Users should not change the DIP switch settings unless they have the proper test equipment to verify their results. Users change de-emphasis, output swing and receive equalization at their own peril. The default DIP switch configuration is shown below:

POSITION	SWITCH S1	SWITCH S2	SWITCH S3
1	OFF	OFF	ON
2	OFF	ON	ON
3	ON	OFF	ON
4	ON	OFF	OFF

4.4 PCIe-451 LED INDICATORS

The PCIe-451 has eighteen LEDs to indicate PCIe link status. Each slot and the cable have two, redundant, LED link status indicators. Nine surface mount LEDs, one for each slot and one for the cable are arranged in a column near the PCIe cable connector, see Figure 5-2. The LEDs are labeled "J1" through "J8" and "CABLE". At each slot, there is an LED located just off axis to the bottom side of an installed board so as not to be obscured by components on the add-in card. The LEDs are labeled "J1" through "J8". The second LED for cable link status is the top, yellow LED of the rear panel LED tower.

A slot linked at Gen2 rates will have its LEDs ON solid. A slot linked at Gen1 rates will indicate status with BLINKING LEDs. Likewise, the CABLE LED should be ON indicating the link to the host is Gen2 and will BLINK if a Gen1 link with the host has been established.

The bottom, green LED of the rear panel LED tower indicates both a "power good" status and that the "cable present signal" back to the host is being asserted.

The last PCIe-451 LED is the red, "POWER" LED which under normal conditions is OFF. It will be on momentarily at power up then remain OFF. If ON, it is indicating a failure of one of the on-board voltages. This LED blinking could indicate a problem with a lightly loaded, unstable power supply.

CHAPTER 5
PHYSICAL CONFIGURATION

5.1 PHYSICAL CONFIGURATION

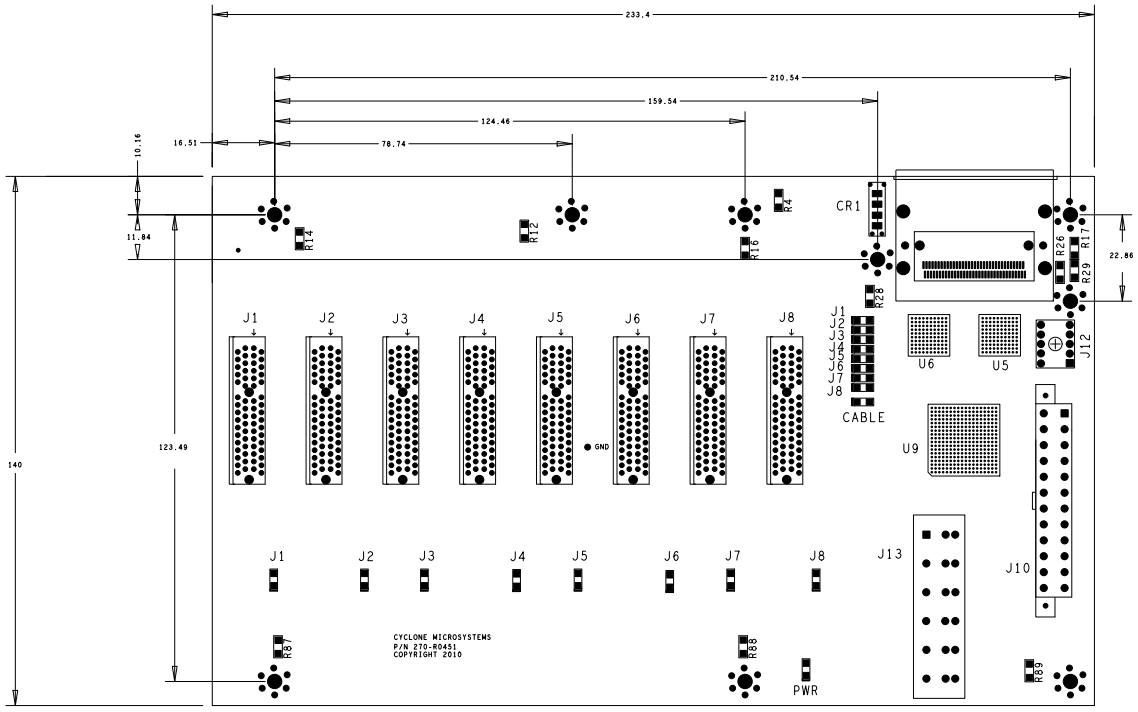

Figure 5-1. PCIe-451 Physical Configuration

Figure 5-1 is a physical diagram (not to scale) of the PCIe-451 backplane, showing the location designators of LEDs, connectors, and major ICs. Refer to this figure when component locations are referenced in the manual text.

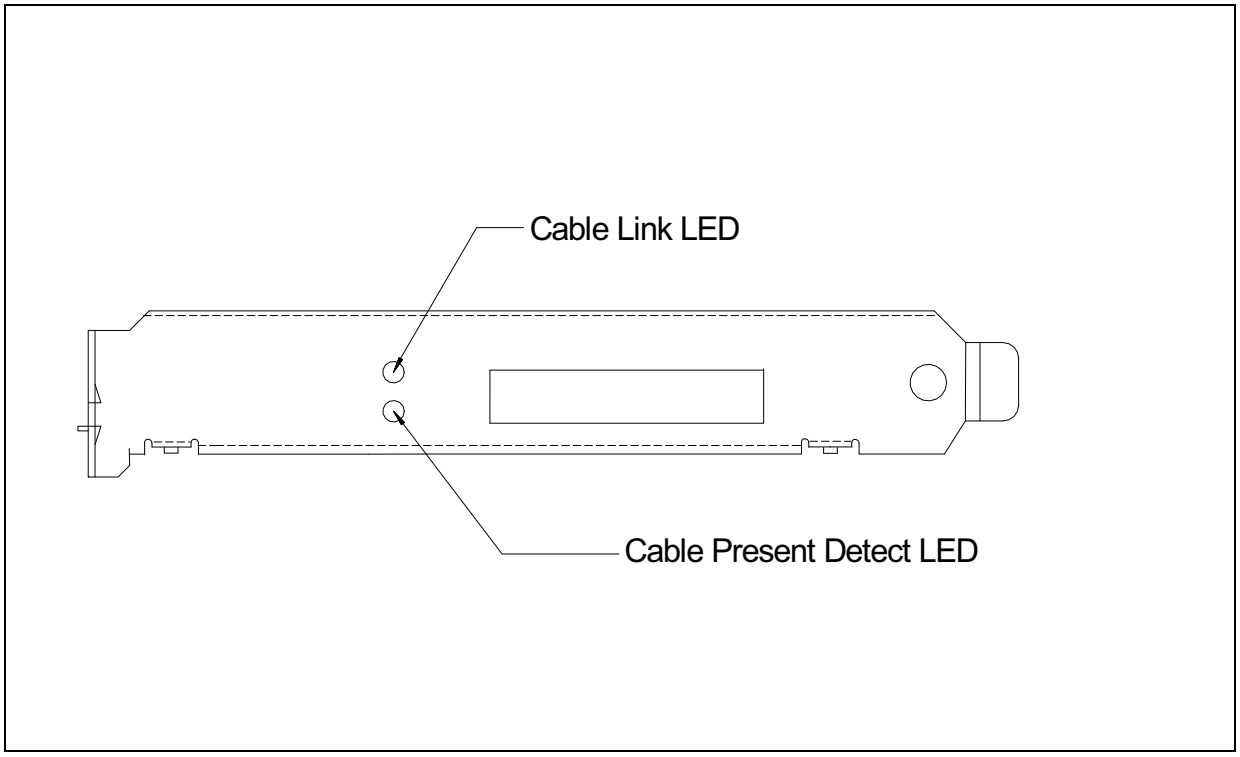

Figure 5-2. PCIe-425 Front Panel

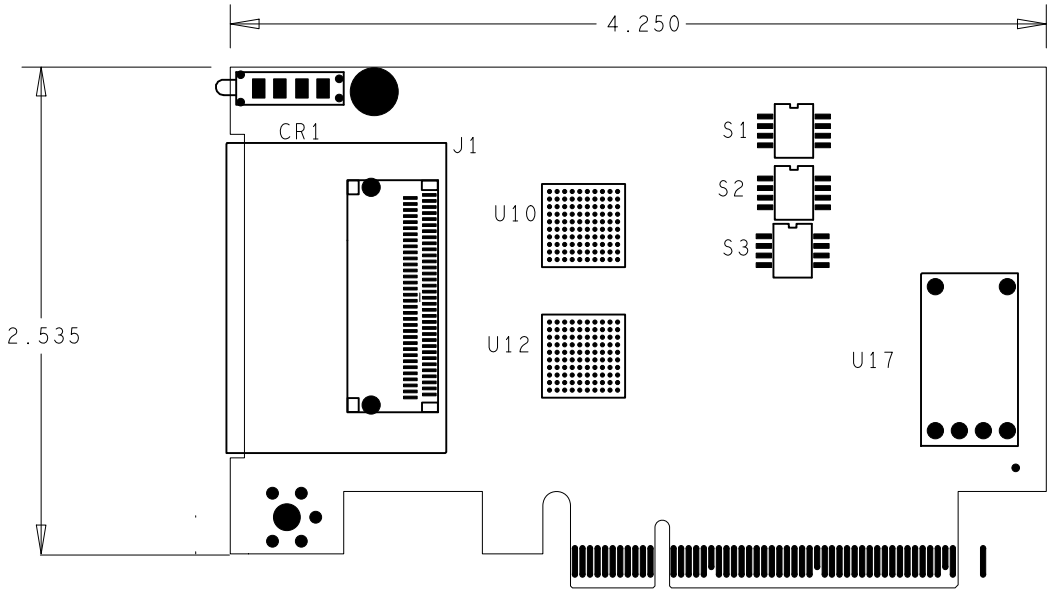

Figure 5-3. PCIe-425 Physical Configuration

Figure 5-4. 600-2708 Chassis

CHAPTER 6
REFERENCE

6.1 REFERENCE MANUALS

PEX 8618 16-Lane, 16-Port PCI Express Gen2 Switch Data Book Version 1.0
PLX Technology, Inc.
Sunnyvale, CA
(800) 759-3735
www.plxtech.com

PCI Express Base Specification Revision 2.0
PCI Express Card Electromechanical Specification Revision 2.0
PCI Express External Cabling Specification Revision 2.0
PCI Local Bus Specification Revision 2.2
PCI-X Addendum Revision 1.0
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