

**600-2701  
EIGHT SLOT PCI  
EXPRESS  
EXPANSION SYSTEM  
USER'S MANUAL**

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## 1.1 INTRODUCTION

The Cyclone Microsystems' 2701 PCI Express Expansion System is a PCI Express (PCIe) expansion system that allows the user to add up to eight PCI Express add-in cards to a PC host system. Most PCs contain few PCI Express slots making them poorly suited for embedded systems requiring a wealth of different I/O boards and co-processor resources.

The 2701 PCI Express Expansion System's eight PCI Express slots are organized as two x8 slots and six x4 slots. All expansion slots accommodate full length and full height cards and are cooled by two 108 CFM fans. A 460 watt supply powers the rack mounted expansion chassis.

The Expansion System supports 20 Gb/s bi-directional traffic to and from the host system and utilizes non-blocking PCI Express switches for excellent peer-to-peer I/O bandwidth. For PCs with modern BIOSs, the 2701 Expansion System is recognized by the host system upon boot-up, requires no hardware specific drivers, and is entirely host operating system agnostic.

The 600-2701 system is composed from three elements: a PCI Express Host Bus Cable Adapter, an Expansion System Cable and an Expansion Chassis. Our PCIe-401 Host Cable Bus Cable Adapter card is inserted into a host computer's PCIe slot. PCIe expansion cable links the PCI host with the expansion chassis. The expansion chassis is populated with the PCIe-411 Switched Backplane with Hot Plug support.

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.

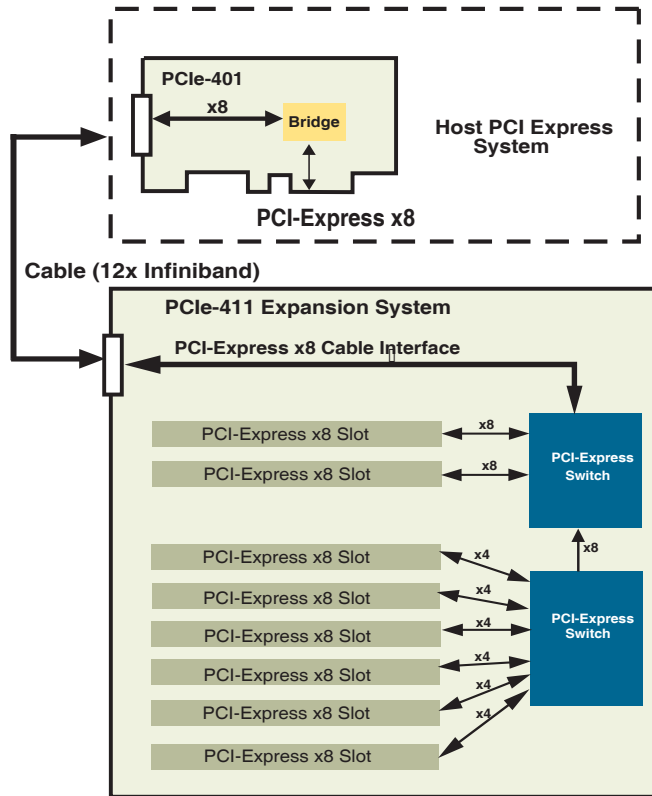


Figure 1-1. 600-2701 Block Diagram

**1.2 SPECIFICATIONS**

The specifications in table 1-1 detail the 600-2701 expansion system chassis including the PCIe-411 expansion backplane and the 460W power supply. The chassis also includes fan which provide 180 CFM cooling.

**Table 1-1. Specifications**

<b>Physical</b>	Height	7 inches
	Width	17 inches
	Depth	22 inches
	Other	19 inch rack mountable
<b>Electrical</b>	Voltage	90 ~ 264 VAC full range
	Frequency	47 ~ 63 Hz.
	Input Current	8.0 A for 115 VAC, 4.0 A for 230 VAC.
	Inrush Current	65 A max. for 115 VAC 125 A max. for 230 VAC
<b>Environmental</b>	Operating Temperature	0 to 40 Degrees Celsius
	Relative Humidity	0% to 90% (non-condensing)
	Storage Temperature	-20 to 70 Degrees Celsius

**1.3 STANDARDS**

PCI Express Base Specification Revision 1.1

PCI Express Card Electro Mechanical Specification 1.1

### 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 is 2.5 Gigabits/second/Lane/direction. A link supports at least one Lane.

The PCI Express link from the PCIe-401 over the cable to the PCIe-411 is an eight lane (x8) link. The PCIe-411 provides two eight lane (x8) slots and six four lane (x4) slots. Each slot can accommodate either single lane (x1), x4 or x8 add-in cards. In the case where a x8 add-in card is installed into a x4 slot, only the first four lanes on the add-in card will be utilized. This situation is termed “down-shifting”. Per the PCI Express Specification, down-shifting is only allowed in this case. All slot connectors on the PCIe-411 are mechanically x8 with the x4 slots leaving the upper four lanes not connected. Up-plugging, i.e., plugging a smaller link card into a larger link connector, is fully allowed.

Once the PCIe-401 is installed into the host PC, the cable connected to the PCIe-411, the chassis is plugged into an AC power outlet and any desired add-in cards are installed, the system is ready to be turned on. 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 both of the Cyclone Microsystems’ cards that indicate both the links that are trained and the individual lanes. 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-401 to the PCIe-411 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 ability to handle 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.

### 3.1 600-2701 CHASSIS

The PCIe-411 is installed into an eight slot rack-mountable chassis. The chassis provides access to two x8 PCI Express slots and six x4 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 by the user to install peripherals for their particular application. There are several ATX four pin peripheral power connectors available from the power supply.

The chassis contains a 460W power supply. Tables 3-1 through 3-3 show the power consumption for the Cyclone Microsystems boards and the power supplied to the PCI Express slots. Note that the PCIe-401 is installed in and powered by the host supply. In a fully populated system, with each PCI Express add-in card drawing 25W, there is an additional 180W, +5V and +12V, available for use via the peripheral power connectors. The +12V available from the peripheral power connector is limited to 10A.

### 3.2 POWER CONSIDERATIONS

**Table 3-1. PCIe- 411 Power Requirements**

Voltage	Current Typical	Current Maximum
+3.3V	0.86 Amps	1.1 Amps
+5V	2.71 Amps	3.36 Amps
+12V	0.01 Amps	0.02 Amps

**Table 3-2. PCIe- 401 Power Requirements**

Voltage	Current Typical	Current Maximum
+3.3V	0.37 Amps	0.46 Amps
+12V	0.30 Amps	0.40 Amps

**Table 3-3. Power Supplied Per PCIe Slot**

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

\* Required by the PCI Express Card Electromechanical Specification Revision 1.1. Note that the total power for each PCIe shall not exceed 25W.

Airflow in the 600-2701 chassis is provided by two 108 CFM located at the front of the chassis.



### 4.1 SYSTEM POWER UP

The host PC with the PCIe-401 installed controls power-up for the entire system. The 12x Infiniband cable is used to connect the x8 link between the PCIe-401 and the PCIe-411. The cable should be connected between both boards and the 600-2701 power cord should be connected to the chassis and plugged in to a power socket. There is a power button on the front of the 600-2701 Expansion Chassis but 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 cable to turn on the 600-2701. If the chassis does not power up, make sure that all cards are seated properly, the chassis is plugged in and the PCI Express cable is connected properly. There is only one LED on the front of the expansion chassis that has meaning. The green LED indicates that the chassis is powered.

### 4.2 SEATING OF CARDS

Unlike standard PC applications, the 2701 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 insure correct electrical connecting 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 LINK INDICATION - LED DEFINITION PCIE-401

There are many LED indicators on both of the printed circuit boards (PCBs) that tell the user the status of all links and individual lanes. Also, see Figure 5-1. The PCIe-401 has two banks of eight LEDs. These LEDs are located on the top side or component side of the PCB. Each LED corresponds to one lane of that particular link. One bank is labeled "UP LN 0" (upstream) and the other bank is labeled "DWN LN 0" (downstream).

The eight upstream LEDs give the state of the link from the PC host that the PCIe-401 is installed into to the PCIe-401. If the PCIe-401 is installed into a x8 or x16 slot, then all eight of the upstream LEDs should be on. Since the PCIe-401 upstream port is an x8 link, only eight lanes of a x16 slot will be used. If less than the eight LEDs are on, there is a problem with the link between the PC host and the PCIe401. If the PCIe-401 is installed into a x4 PCIe slot (down-shifting), then only the first four LEDs will be on and the link is trained at x4. If none of the upstream LEDs are on, turn off the host PC and make sure that the PCIe-401 is properly seated into the PCIe connector.

The eight downstream LEDs indicate the status of the link connecting the PCIe-401 to the PCIe-411 via the PCI Express cable. If the PCIe-401 is installed into an x8 or a x16 slot and the eight upstream LEDs are on, the PCIe-401 is connected via the PCIe cable to the PCIe-411, all eight of the downstream LEDs should be on. If the PCIe-401 is installed into a x4 slot, there still should be all eight downstream LEDs on. If less than eight LEDs are on, check to make sure that the cable is properly connected to each board.

#### 4.4 LINK INDICATION - LED DEFINITION PCIE-411

The PCIe-411 has several sets of surface mount located on the top side of the PCB see Figure 5-2. The LEDs are arranged in groups of either eight or four LEDs. As with the above board, each LED corresponds to an individual lane within that particular link. There are eleven groups of LEDs and their definition is shown in Table 4-1. Additionally, there are sixteen individual LEDs. These LEDs are labeled PWRA through PWRH and ATTA through ATTH. These PWR LEDs are illuminated and simply indicate when an add-in card is installed and powered in the corresponding slot. The ATT LEDs are indicators for the attention buttons. Attention buttons are utilized in when Hot Plugging boards into the PCIe-411. Hot Plug is described in section 4.5. The LEDs labeled “UP” and S2, the LEDs between the PCIe-401 and the PCIe-411 and between the two PCI Express switches, should be on at all times. The slot LEDs indicate the active lanes to the corresponding add-in card. If no add-in card is installed into a particular slot, the LEDs for that slot will be off. If a x1 or x4 add-in card is installed into a x8 slot, only 1 (position 0) or 4 LEDs (LEDs 0 through 3) respectively, will be on. Similarly, x1 add-in cards installed into x4 slots should only have the first LED on. Add-in cards that are down-shifted, x8 cards in x4 slots, should have all four of the lane indicator LEDs on.

**Table 4-1. PCIe-411 LED Banks**

LED LABEL	LED FUNCTION
SLOT A 0->3	Slot A is a four lane port
SLOT B 0->3	Slot B is a four lane port
SLOT C 0->3	Slot C is a four lane port
SLOT D 0->3	Slot D is a four lane port
SLOT E 0->3	Slot E is an four lane port
SLOT F 0->3	Slot F is an four lane port
SLOT G 0->7	Slot Gis an eight lane port
SLOT H 0->7	Slot H is an eight lane port
UP 0 0->7	x8 link from the PCIe-401 to the PCIe-411 (U14)
UP 1 0->7	x8 link between PCIe switches, U22 to U14
S2 0->7	x8 link between PCIe switches, U14 to U22

#### 4.5 HOT PLUG - PCIE-411

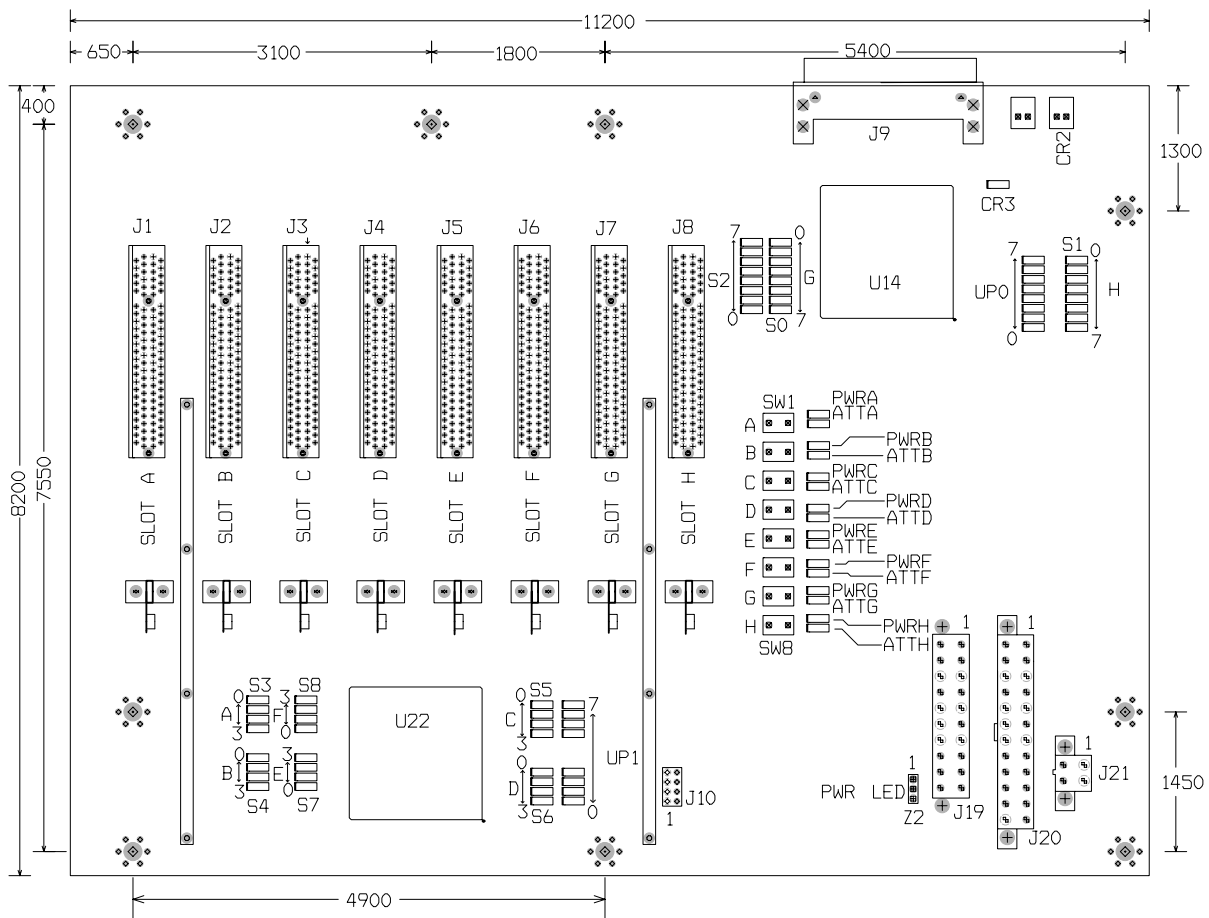
The Hot Plug capabilities of the PCIe-411 allow for insertion and extraction of an add-in card from a running system without adversely affecting the system. Board insertion or extraction is accomplished for faulty board repair or system reconfiguration without system down time. The PLX PEX 8532 switches used on the PCIe-411 contain one Hot Plug Controller per port, each of which is compliant with the PCI Standard Hot Plug R1.0.

Hot Plug support requires significant software development. Cyclone does not provide O/S support for Hot Plug, and users wishing to develop software to support HotPlug should consult chapter 9 of the PEX 8532 documentation. A description of the Hot Plug sequence from an operator’s point of view including a description of the PWR and ATT LEDs and ATT button can be found in the PCIe-411 User’s Manual.

**5.1 PHYSICAL CONFIGURATION**

Figure 5-1 is a physical diagram (not to scale) of the PCIe-411 backplane, showing the location designators of jumpers, connectors, and major ICs. Refer to this figure when component locations are referenced in the manual text. Figure 5-2 is a physical diagram of the PCIe-401 adapter. Figure 5-3 is a drawing of the 2701 chassis showing the location of the PCIe-411, the power supply, fans, etc.

**Figure 5-1. PCIe-411 Physical Configuration**



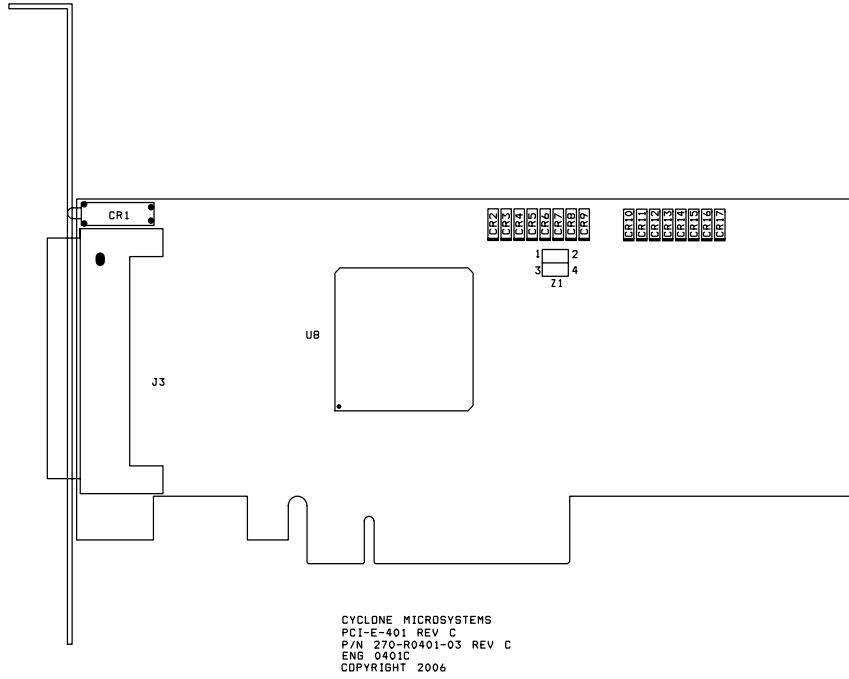
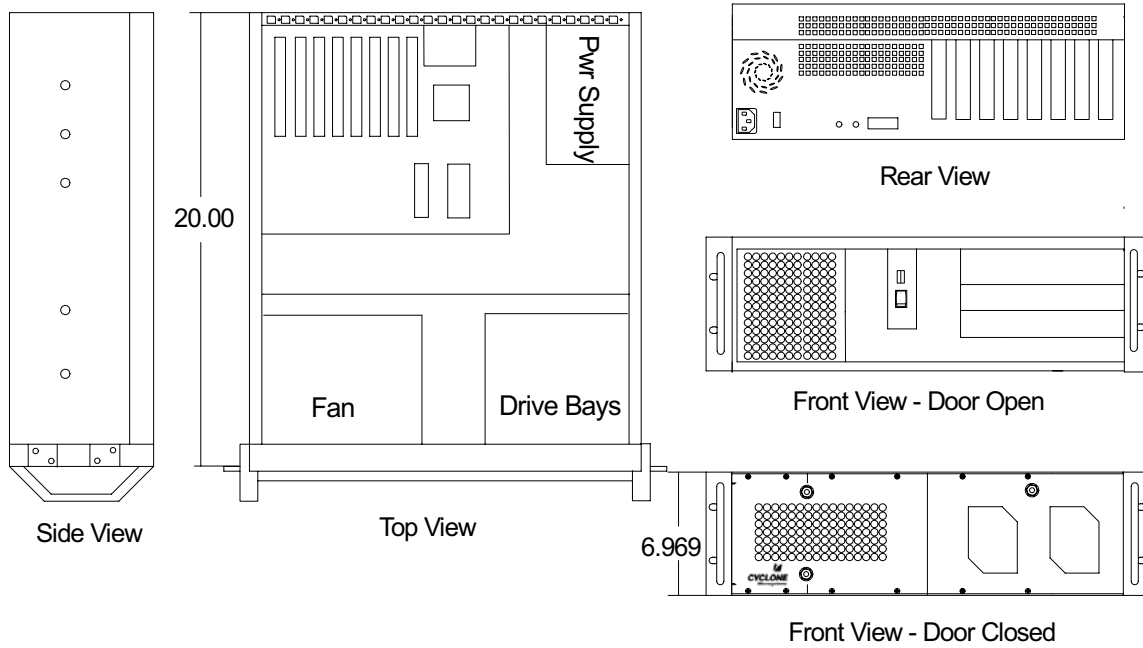


Figure 5-2. PCIe-401 Physical Configuration



**Figure 5-3. 600-2701 Chassis**



## CHAPTER 6 REFERENCE

### 6.1 REFERENCE MANUALS

PEX 8532 Versatile PCI Express Switch Data Book Version 1.1  
PLX Technology, Inc.  
Sunnyvale, CA  
(800) 759-3735  
[www.plxtech.com](http://www.plxtech.com)

PCI Express Base Specification Revision 1.0a  
PCI Express Card Electromechanical Specification Revision 1.0a  
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