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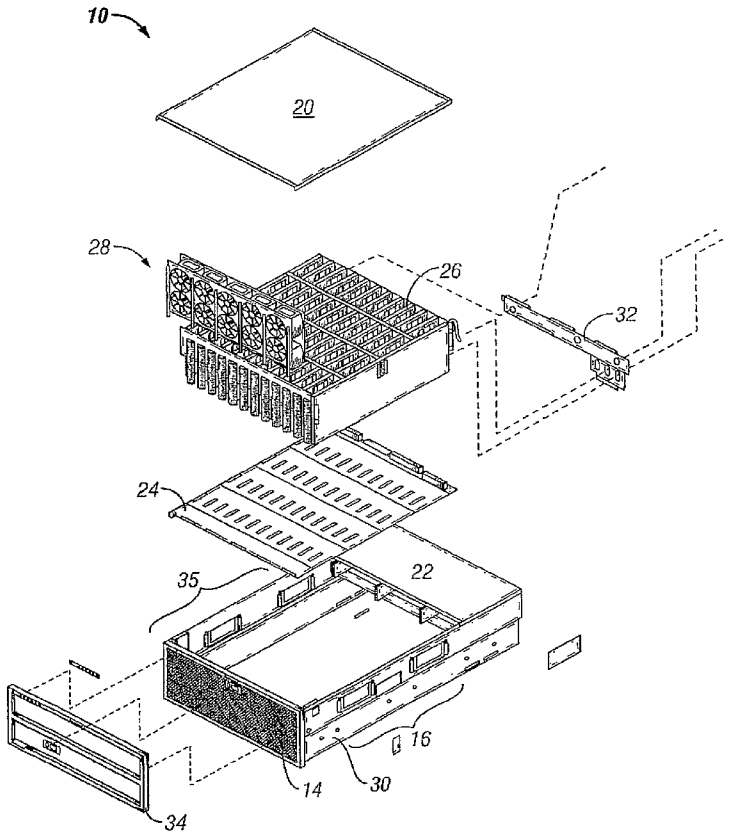
(54) Title: COMPACT RACKMOUNT STORAGE SERVER



(57) Abstract: A rackmount storage server has a printed circuit board (PCB) having connectors for connecting with a plurality of top-loading storage devices.. A controller assembly having a PCI expansion slot, is arranged to operatively connect to the passive backplane from a rear side of the PCB. Further, the rackmount storage server has redundant cooling unit for facilitating air flow in an interior region of the rackmount storage server. Further, the rackmount storage server may have an integrated battery for saving power for use in case of, for example, a power failure.

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COMPACT RACKMOUNT STORAGE SERVER

BACKGROUND

As generally referred to in the art, a "server" is a computing device that is configured to perform operations for one or more other computing devices connected over a network. For an entity that requires computing infrastructure for handling relatively large amounts of network data, it is desirable to use servers that are designed to promote organizational/space efficiency and operational performance. In this regard, some servers are designed to be arranged in a "rack," whereby the rack (or "cabinet") houses numerous servers that are arranged, or "mounted," vertically one on top of another (however, not necessarily in contact with one another). Such a server is generally referred to in the art as a "rackmount" server.

Rackmount servers are generally designed having a height corresponding to whole multiples of an industry standard rack mounting height dimension. For example, rackmount servers are generally referred to as "2U," "3U," "4U," etc. systems, where the "U" designation refers to one dimensional increment of 1.75 inches in height along the vertical members of an Electronics Industry Alliance (EIA) industry-standard computer racking/mounting structure. Thus, for example, a 2U rackmount server is generally designed to be approximately 3.5 inches in height, less a small amount of clearance between vertically-adjacent rackmount servers in the rack (those skilled in the art will note that a standard rack is 19 inches wide; however, racks of other widths are available).

In view of size constraints and limitations of a rackmount server, it is important to combine and arrange components in the rackmount server in a manner that promotes operational performance and space efficiency.

SUMMARY

According to one aspect of one or more embodiments of the present invention, a server comprises: a printed circuit board (PCB) disposed along an

inside surface of the server, where the PCB has a plurality of connectors adapted to be connected to a plurality of top-loading storage devices; and a controller assembly operatively connected to the PCB from a rear side of the PCB.

[005] According to another aspect of one or more embodiments of the present invention, an apparatus comprises: a chassis; a PCB having a first connector connectable to a second connector integral with a hard disk insertable from a top portion of the chassis; and a controller assembly operatively connectable to a rear side of the PCB, the controller being accessible from a rear side of the chassis.

[006] According to another aspect of one or more embodiments of the present invention, a rackmount storage server comprises: a passive backplane; top-loading hard disks each having a native connector pluggable into the passive backplane; and a controller operatively connected to the passive backplane from a rear side of the passive backplane.

[007] Other aspects of the present invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[008] Figure 1 shows a rackmount storage server in accordance with an embodiment of the present invention.

[009] Figure 2 shows an exploded perspective view of a rackmount storage server in accordance with an embodiment of the present invention.

[0010] Figure 3 shows a portion of a rackmount storage server in accordance with an embodiment of the present invention.

[0011] Figure 4 shows an exploded perspective view of a portion of a rackmount storage server in accordance with an embodiment of the present invention.

[0012] Figure 5 shows an exploded perspective view of a portion of a

rackmount storage server in accordance with an embodiment of the present invention.

[0013] Figure 6 shows a chassis mechanical drawing.

[0014] Figure 7 shows two major components of an exemplary embodiment of a rackmount storage server.

[0015] Figure 8 shows a block diagram of an exemplary embodiment of a rackmount storage server.

[0016] Figure 9 shows two 144-circuit hi-speed dock connectors of an exemplary embodiment of a rackmount storage server.

[0017] Figure 10 shows the face plate for the System Controller of an exemplary embodiment of a rackmount storage server.

[0018] Figure 11 shows a USB connector.

[0019] Figure 12 shows a Serial connector.

[0020] Figure 13 shows a 10/100BaseT connector.

[0021] Figure 14 shows a 10/100/1000BaseT connector.

[0022] Figure 15 shows an S-ATA connector.

[0023] Figure 16 shows a VGA connector.

DETAILED DESCRIPTION

[0024] Specific embodiments of the present invention will now be described in detail with reference to the accompanying figures. Like elements in the various figures are denoted by like reference numerals for consistency. Further, in the following detailed description of embodiments of the present invention, numerous specific details are set forth in order to provide a more thorough understanding of the present invention. In other instances, well-known features have not been described in detail to avoid obscuring the description of embodiments of the present invention.

[0025] Generally, embodiments of the present invention relate to a rackmount storage server having a novel combination and/or arrangement of components. Figure 1 shows an example of a rackmount storage server **10** in accordance with an embodiment of the present invention. A front side **12** of the rackmount storage server **10** is formed of a vented surface **14** arranged to allow for the passage of air between a region interior to the rackmount storage sever **10** and a region exterior to the rackmount storage server **10**. A right side **16** of the rackmount server **10** (and a left side of the rackmount server **10**, the left side not being visible in Figure 1) is formed of an attachment mechanism **18** for mounting the rackmount server **10** to a rack (or cabinet) (not shown) arranged to hold the rackmount server **10**. Further, a first top cover **20** and a second top cover **22** may be used to enclose the rackmount server **10** from a top side, where the top side is defined as the side of the rackmount storage server **10** facing up when the rackmount storage server **10** is mounted in the rack (or cabinet) (not shown).

[0026] Figure 2 shows an exploded perspective view of a rackmount storage server **10** in accordance with an embodiment of the present invention. A chassis portion **30** of the rackmount storage server **10** is shown having left and right sides **35**, **16** each having attachment mechanisms (shown, but not labeled) for mounting the rackmount storage server **10** to a rack (or cabinet) (not shown) arranged to hold the rackmount storage server **10**. Further, a front side of the rackmount server **10** may be attached to a front member **34** as shown in Figure 2.

[0027] A printed circuit board (PCB) **24**, which may be a backplane (passive or active) or motherboard, is arranged to be fitted in the chassis portion **30**. Particularly, the PCB **24** may be positioned along an inner bottom surface of the chassis portion **30**. The PCB **24** has a plurality of connectors arranged to be connected to a plurality of storage devices (not shown), which may constitute hard disks, or other such devices that are used for the storage of data. Each of the plurality of storage devices (not shown) may have their own

native connectors to connect with respective connectors disposed on the PCB **24**.

[0028] As discernible in Figure 2, the plurality of storage devices (not shown) may be loaded from a top side of the rackmount storage server **10**. In other words, each of the plurality of storage devices (not shown) may be "plugged in" from the top of the rackmount storage server **10** to a connector on the PCB **24**. Further, as shown in Figure 2, a storage device housing (such as a disk carrier for enclosing hard disks) **26** is provided to individually and at least partially enclose/house each of the plurality of storage devices (not shown). In other words, the storage device housing **26** provides "slots" for inserting each of the plurality of storage devices (not shown).

[0029] In one or more embodiments of the present invention, one or more of the plurality of storage devices (not shown) may be serial ATA (SATA) disks. Further, in one or more embodiments of the present invention, one or more of the plurality of storage devices (not shown) may be serial attached SCSI (SAS) disks. Further, in one or more embodiments of the present invention, storage devices other than SATA and SAS disks may be used in the rackmount storage server **10**.

[0030] Further, still referring to Figure 2, those skilled in the art will note that, in one embodiment of the invention, a total of 48 storage devices may be inserted in the rackmount storage server **10**. The 48 storage devices may be arranged in 4 rows of 12 storage devices each as shown in Figure 2. However, in one or more other embodiments of the present invention, a different number and/or different arrangement of storage devices may be used.

[0031] Along a front side of the rackmount storage server **10** are disposed a plurality of cooling devices **28**. The cooling devices **28** in Figure 2 are arranged as two rows of fans (further described below). The cooling devices **28** are arranged to provide redundant airflow through an overall region of the rackmount storage server **10**. Those skilled in the art will note that in one or

more embodiments of the present invention, a different number and/or different arrangement of cooling devices **28** (than that shown in Figure 2) may be used.

[0032] Referring again to the PCB **24** shown in Figure 2, the PCB 24 is arranged to be connected to an attachment means **32** for attaching the PCB **24** and the storage device housing 26.

[0033] Further, top cover **22** is arranged to at least partially enclose/house a controller assembly as further described now with reference to Figure 3. In Figure 3, a controller assembly **40** is arranged to connect to the PCB 24 from a rear side of the PCB **24** as shown in Figure 2. As discernible from Figures 2 and 3, the controller assembly **40** is arranged to be positioned in the rackmount storage server **10** from a rear side of the rackmount storage server **10**. In one or more embodiments of the present invention, the controller assembly **40** may be arranged having general purpose server architecture capable of running one or more general purpose applications.

[0034] Further, in one or more embodiments of the present invention, the controller assembly **40** may be arranged to support peripheral component interconnect (PCI) (e.g., PCI-X, PCI-Express) expansion slots. Accordingly, the controller assembly **40** may be provided with PCI I/O connectivity from a rear side of the rackmount storage server **10**.

[0035] Figure 4 shows an exploded perspective view of a controller assembly **40** in accordance with an embodiment of the present invention. The controller assembly **40** contains a bottom chassis portion **42** in which a connector card **44** is arranged to be positioned. The connector card **44** may be arranged to connect to the PCB **24** shown in Figure 2. Further, a CPU board assembly **46** may be positioned on the connector card **44** as shown in Figure 4. The CPU assembly **46** may include processors, memory devices or other such components. Either of the connector card **44** or the CPU board assembly **46** may have slots (or connectors) (shown, but not labeled) for various components (e.g., memory modules, PCI cards, application specific cards,

network cards).

[0036] Referring back to Figure 2, cooling devices **28** are positioned in the rackmount storage server **10** to provide and facilitate airflow in the rackmount storage server **10**. Figure 5 shows an exploded perspective view of a module **50** forming the cooling devices **28**. The cooling device module **50** is formed of two separate fan units **52, 54**. The two fan units **52, 54** are arranged to direct air into the rackmount storage server **10**. In other words, the two fan units **52, 54** are arranged to direct cool air from a region exterior of the rackmount storage server **10** into an interior region of the rackmount storage server **10**. However, in one or more embodiments of the present invention, one or both of the fan units **52, 54** may be arranged to direct air out from the rackmount storage server **10**. In this case, hot air from within an interior region of the rackmount storage server **10** is directed to a region exterior of the rackmount storage server **10**. In one or more embodiments of the invention, at least one fan directs air from a region exterior into the rackmount storage server **10**, while another fan directs air from the interior of the rackmount storage server **10** to an exterior region.

[0037] Still referring to Figure 5, the two fan units **52, 54** may be attached to a singular fan unit cover piece **56**. The singular fan unit cover piece **56** may be arranged to filter out large particles from entering an interior region of the rackmount storage server **10**. Further, in one or more embodiments of the present invention, the singular fan unit cover piece **56** may be arranged to attract smaller dust particles so as to prevent such particles from entering an interior region of the rackmount storage server **10**. Further, a bracket piece **58** may be used for attaching the singular fan unit cover piece **56** (and accordingly, the two fan units **52, 54**) to a front portion (not shown in Figure 5, but discernible in Figure 2) of the rackmount storage server **10**.

[0038] Further, in one or more embodiments of the present invention, a built-in or integrated UPS battery may be incorporated in the rackmount storage server **10**. The built-in UPS battery may be arranged to allow the rackmount

storage server **10** to save data in a main memory to one or more of a plurality of hard disks in the rackmount storage server **10** in the case, for example, of a power failure.

[0039] Advantages of the present invention may include one or more of the following. In one or more embodiments of the present invention, a rackmount storage server has a combination of storage devices, a PCB, and a controller assembly that promotes operational performance and/or space and cooling efficiency.

[0040] In one or more embodiments of the present invention, one or more storage devices may be "plugged in" from a top side of a rackmount storage server, thereby possibly easing the insertion and connection of the hard disks into the rackmount storage server. Further, the storage devices are hot-swappable.

[0041] In one or more embodiments of the present invention, a controller assembly of a rackmount storage server may be arranged with PCI card expansion slots for improved and/or desirable I/O.

[0042] In one or more embodiments of the present invention, a relatively large number of top-loading hard disks, e.g., 48 top-loading hard disks, may be used to provide data storage in a rackmount storage server.

[0043] In one or more embodiments of the present invention, a rackmount storage server may use a plurality of redundant cooling units to facilitate air flow in the rackmount storage server.

[0044] In one or more embodiments of the present invention, a rackmount storage server may use a plurality of redundant cooling unit to facilitate airflow throughout an interior region of the rackmount storage server.

[0045] In one or more embodiments of the present invention, a controller of a rackmount storage server may have general purpose architecture to run one or more general purpose applications.

[0046] In one or more embodiments of the present invention, an integrated battery in a rackmount storage server may be used to save data from volatile memory (e.g., main memory) to non-volatile memory (e.g., a hard disk) in case of a power failure.

[0047] A detailed example of a rackmount storage server in accordance with the present invention is presented below in the form of a product specification. This specification describes the functionality, major components and subsystems, external interfaces, and operation of a server known as the Sun Fire X4500 available from Sun Microsystems, Inc.

[0048] With 48 500GB hard drives, the Sun Fire x4500 system has raw storage capacity of 24 terabytes in 4U. The Sun Fire x4500 system has two (2) PCI-X expansion slots. Two 10GigE NICs are installed into the slots. There are four (4) 1000BaseT links. The disk array is controlled by a 2-socket (dual-core capable) MP AMD Opteron™ processor subsystem.

[0049] An overview of supported Sun Fire x4500 features is shown in Table 1.

Feature	Specification
Hard disks supported	48
Hard disk type	Serial-ATA I
Processor	AMD64 Opteron (1MByte L2 cache per CPU chip) – dual core capable within power budget
Processor Configurations	Dual ONLY
Memory Type	PC3200 400 MHz Registered DIMMs with ECC PC2700 333 MHz Registered DIMMs with ECC
Memory Size	4 DDR-I DIMM slots per processor
Memory Capacities	512MB, 1GB, 2, or 4 GB per DIMM
Processor BIOS	STMicro 8 Mbit Flash with LPC Interface
Embedded Boot Device	Type-II Compact Flash slot (NOT hot-swappable)
Service Processor (SP)	Motorola PowerPC 8248 @ 266MHz
SP Interface	10/100BaseT Ethernet port, I^2C connection to AMD8111, Serial port [serial port is multiplexed with the main serial port]
IO Ports	10/100/1000BaseT Ethernet (RJ45 Connector) x 4 10/100BaseT Ethernet (RJ45 Connector) [for SP] RS-232 Serial Interface (RJ45 Connector) Four (4) USB 2.0 Ports (Type A Connector) (2x in front and 2x in rear) Video Port (VGA Connector)

Table 1 – Sun Fire x4500Feature Summary

[0050] The Sun Fire x4500 includes an extensive set of RAS (Reliability,

Availability, and Serviceability) Features, such as: hot-swappable and redundant fans and power supplies, remote lights-out server management, remote boot and remote software upgrades. The RAS feature also has Intelligent Systems Management including: SP (Service Processor), TPM (Trusted Platform Module), ECC Memory and Cache, and Predictive Failure Analysis, Hot-swap Fans, Hot-swap Power Supplies, Temperature and Voltage Monitoring, and KVM Redirection over Ethernet.

[0051] Figure 6 illustrates the mechanical layout of the Sun Fire x4500, which is implemented in a custom 4U rack-mountable chassis **60**. The chassis **60** provides one controller FRU slot, one disk backplane, five fan trays **62**, two power supplies in a 1+1 redundant configuration with an extra slot for a battery backup unit **64**, and 48 disk slots **66**. The five fan trays **62**, each containing two individual fans, provide cooling for the system. In one embodiment, the fans can provide 300 CFM of airflow, from the front to the back of the chassis **60**. The fan speed is variable, adjusting for the ambient conditions, the number of disks, and the system load. The system tolerates a single fan failure without compromising the cooling. Fan trays are hot-swappable. The power supplies may have additional fans to provide cooling during standby mode. Sun Fire x4500 provides module-level redundancy and hot-swappability for the power supplies and the hard drives. The Sun Fire x4500 provides the external interfaces described in Table 2.

Type	Qty	Connector Type	Description
133MHz PCI-X Slots	2	64-bit PCI-X	
10/100/1000BaseT Ethernet	4	RJ45	
10/100BaseT Ethernet	1	RJ45	Management port for SP
RS-232 serial port	1	RJ45	Console port (multiplexed)
USB	4	USB Type A	2x in front, 2x in rear
Compact Flash	1	50-pin Type-II CF	Compact Flash for CPU file system
220V AC input	3	Standard IEC-320 connector	AC input located on power supply

Table 1 – Sun Fire x4500 External Interfaces

[0052] Sun Fire x4500 consists of two major components as shown in Figure 7.

The first major component is the Controller Assembly **70**, which contains the network interfaces, the processors, and the disk controllers, along with all management functionality. A Service Processor connected to the I/O Card monitors the status of the system and can be queried regardless of the state of rest of the system as long as there is standby power from one of the main supplies. The second major component of the system is the disk backplane **71**, which contains the power and data connections for all of the hard drives, as well as the connections to the main power supplies, the battery backup unit, and fans. All of the hard drives are Serial ATA hard drives and support hot-swapping. The fan controller/driver resides on the Controller Assembly **70**, but the tachometer signals are monitored on the disk backplane.

[0053] A more detailed block diagram of the Sun Fire x4500 system is shown in Figure 8. The Controller Assembly **70** includes an I/O-Board **80**, a CPU-Board **81**, a Graphics/SP-board **82**, and a Service Processor **83**. The I/O-board **80** contains the PCI-X Bridges, SouthBridge, S-ATA controllers and all I/O connectors. The CPU-board **81** contains the processors and the associated DDR DRAM memory. All of the control and datapath functionality, with the exception of the disks themselves, reside in the Controller Assembly **70**. The Sun Fire x4500 includes two AMD Opteron™ processors, interconnected through AMD's HyperTransport technology. There are also HyperTransport links to PCI-X bridges and the AMD Southbridge, which connects to all standard I/O. All external connections, with the exception of power and the front USB ports, come into the Controller Assembly **70**. In some cases, such as temperature, a separate interrupt immediately alerts the processors in case of a problem.

[0054] The Graphics/SP-board **82** plugs into a special slot on the I/O-board **80**, and is connected to the Service Processor **83**. **||NOTE: We need to simplify Figure 8 to show a block 83 for the SP in place of the overly detailed components QS, TPM, etc.||** The Service Processor (SP) **83** monitors the system and can report if there is a problem with the system, even if the main

processors are not operating properly. The Service Processor **83** also monitors temperature and voltages, and has an RS-232 console port and an Ethernet management port for connectivity to the outside world. Service Processor **83** software detects fan failure, provides a front panel failure indication, generates a corresponding failure indication to the management system, and illuminates the individual fan failure LED indicator.

[0055] As discussed above, the disk backplane **71** contains the power and data connections for all of the hard drives, as well as the connections to the main power supplies, the battery backup unit and fans. All of the hard drives are Serial ATA hard drives and are hot-swappable. The individual power supplies connect to the disk backplane **71** through a power backplane **84**. The I/O-board **80** connects to the disk backplane **71** through a combination of a Molex hi-speed dock connector and a PowerBlade connector. For all differential pairs, and for some of the single-ended control signals, two 144-circuit hi-speed dock connectors **90**, **91** as shown in Figure 9 are used. The fixed connector **90** is mounted on the disk backplane **71**. The mating floating connector **91** is mounted on the I/O controller card **80**. The I/O card **80** to disk backplane **71** connector pin-outs are set forth below in Tables 3 and 4.

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
A1	FRONT_USB_P	B1	SHORT_PIN1	C1	POWER_BUTTON_L
A2	FRONT_USB_N	B2	P3_3V	C2	LOCATE_BUTTON_L
A3	5V_AUX	B3	5V_AUX	C3	P5V
A4	PS2_BATT_L	B4	GND	C4	GND
A5	DISK36_TX_P	B5	DISK36_RX_N	C5	DISK24_TX_P
A6	DISK36_TX_N	B6	DISK36_RX_P	C6	DISK24_TX_N
A7	DISK24_RX_N	B7	DISK12_TX_P	C7	DISK12_RX_N
A8	DISK24_RX_P	B8	DISK12_TX_N	C8	DISK12_RX_P
A9	DISK36_ACT_LED_L	B9	DISK24_ACT_LED_L	C9	DISK12_ACT_LED_L
A10	DISK13_ACT_LED_L	B10	DISK1_ACT_LED_L	C10	DISK0_ACT_LED_L
A11	DISK0_TX_P	B11	DISK0_RX_N	C11	DISK1_RX_P
A12	DISK0_TX_N	B12	DISK0_RX_P	C12	DISK1_RX_N
A13	DISK1_TX_N	B13	DISK13_RX_P	C13	DISK13_TX_N
A14	DISK1_TX_P	B14	DISK13_RX_N	C14	DISK13_TX_P
A15	DISK25_RX_P	B15	DISK25_TX_N	C15	DISK37_RX_P
A16	DISK25_RX_N	B16	DISK25_TX_P	C16	DISK37_RX_N
A17	DISK37_TX_N	B17	DISK2_RX_P	C17	DISK2_TX_N
A18	DISK37_TX_P	B18	DISK2_RX_N	C18	DISK2_TX_P
A19	DISK25_ACT_LED_L	B19	DISK37_ACT_LED_L	C19	DISK2_ACT_LED_L
A20	DISK38_ACT_LED_L	B20	DISK26_ACT_LED_L	C20	DISK14_ACT_LED_L
A21	DISK14_RX_P	B21	DISK14_TX_N	C21	DISK26_RX_P
A22	DISK14_RX_N	B22	DISK14_TX_P	C22	DISK26_RX_N

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
A23	DISK26_TX_N	B23	DISK38_RX_P	C23	DISK38_TX_N
A24	DISK26_TX_P	B24	DISK38_RX_N	C24	DISK38_TX_P
A25	DISK3_RX_P	B25	DISK3_TX_N	C25	DISK15_RX_P
A26	DISK3_RX_N	B26	DISK3_TX_P	C26	DISK15_RX_N
A27	DISK15_TX_N	B27	DISK27_RX_P	C27	DISK27_TX_N
A28	DISK15_TX_P	B28	DISK27_RX_N	C28	DISK27_TX_P
A29	DISK3_ACT_LED_L	B29	DISK15_ACT_LED_L	C29	DISK27_ACT_LED_L
A30	DISK16_ACT_LED_L	B30	DISK4_ACT_LED_L	C30	DISK39_ACT_LED_L
A31	DISK39_RX_P	B31	DISK39_TX_N	C31	DISK4_RX_P
A32	DISK39_RX_N	B32	DISK39_TX_P	C32	DISK4_RX_N
A33	DISK4_TX_N	B33	DISK16_RX_P	C33	DISK16_TX_N
A34	DISK4_TX_P	B34	DISK16_RX_N	C34	DISK16_TX_P
A35	DISK28_RX_P	B35	DISK28_TX_N	C35	DISK40_RX_P
A36	DISK28_RX_N	B36	DISK28_TX_P	C36	DISK40_RX_N
A37	DISK40_TX_N	B37	DISK5_RX_P	C37	DISK5_TX_N
A38	DISK40_TX_P	B38	DISK5_RX_N	C38	DISK5_TX_P
A39	DISK28_ACT_LED_L	B39	DISK40_ACT_LED_L	C39	DISK5_ACT_LED_L
A40	DISK41_ACT_LED_L	B40	DISK29_ACT_LED_L	C40	DISK17_ACT_LED_L
A41	DISK17_RX_P	B41	DISK17_TX_N	C41	DISK29_RX_P
A42	DISK17_RX_N	B42	DISK17_TX_P	C42	DISK29_RX_N
A43	DISK29_TX_N	B43	DISK41_RX_P	C43	DISK41_TX_N
A44	DISK29_TX_P	B44	DISK41_RX_N	C44	DISK41_TX_P
A45	3_3AUX_IN	B45	3_3AUX_IN	C45	3_3AUX_IN
A46	GND	B46	5V_DISK_SENSE_N	C46	GND
A47	3_3_AUX_SENSE_P	B47	5V_DISK_SENSE_P	C47	SP_I2C_CLK
A48	3_3_AUX_SENSE_N	B48	MAMMOTH_INT_L	C48	SP_I2C_DAT

Table 3 – I/O Card to Disk Backplane Molex Hi-Speed Dock Connector Pin-out

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
A1	12V_SENSE_P	B1	3_3AUX_POWERGOOD	C1	VDD_RTC
A2	12V_SENSE_N	B2	PS1_ENABLE_L	C2	PS0_ENABLE_L
A3	DISK6_RX_P	B3	DISK6_TX_N	C3	DISK18_RX_P
A4	DISK6_RX_N	B4	DISK6_TX_P	C4	DISK18_RX_N
A5	DISK18_TX_N	B5	DISK30_RX_P	C5	DISK30_TX_N
A6	DISK18_TX_P	B6	DISK30_RX_N	C6	DISK30_TX_P
A7	DISK6_ACT_LED_L	B7	DISK18_ACT_LED_L	C7	DISK30_ACT_LED_L
A8	DISK19_ACT_LED_L	B8	DISK7_ACT_LED_L	C8	DISK42_ACT_LED_L
A9	DISK42_RX_P	B9	DISK42_TX_N	C9	DISK7_RX_P
A10	DISK42_RX_N	B10	DISK42_TX_P	C10	DISK7_RX_N
A11	DISK7_TX_N	B11	DISK19_RX_P	C11	DISK19_TX_N
A12	DISK7_TX_P	B12	DISK19_RX_N	C12	DISK19_TX_P
A13	DISK31_RX_P	B13	DISK31_TX_N	C13	DISK43_RX_P
A14	DISK31_RX_N	B14	DISK31_TX_P	C14	DISK43_RX_N
A15	DISK43_TX_N	B15	DISK8_RX_P	C15	DISK8_TX_N
A16	DISK43_TX_P	B16	DISK8_RX_N	C16	DISK8_TX_P
A17	DISK31_ACT_LED_L	B17	DISK43_ACT_LED_L	C17	DISK8_ACT_LED_L
A18	DISK44_ACT_LED_L	B18	DISK32_ACT_LED_L	C18	DISK20_ACT_LED_L
A19	DISK20_RX_P	B19	DISK20_TX_N	C19	DISK32_RX_P
A20	DISK20_RX_N	B20	DISK20_TX_P	C20	DISK32_RX_N
A21	DISK32_TX_N	B21	DISK44_RX_P	C21	DISK44_TX_N
A22	DISK32_TX_P	B22	DISK44_RX_N	C22	DISK44_TX_P
A23	DISK9_RX_P	B23	DISK9_TX_N	C23	DISK21_RX_P
A24	DISK9_RX_N	B24	DISK9_TX_P	C24	DISK21_RX_N
A25	DISK21_TX_N	B25	DISK33_RX_P	C25	DISK33_TX_N
A26	DISK21_TX_P	B26	DISK33_RX_N	C26	DISK33_TX_P

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
A27	DISK9_ACT_LED_L	B27	DISK21_ACT_LED_L	C27	DISK33_ACT_LED_L
A28	DISK22_ACT_LED_L	B28	DISK10_ACT_LED_L	C28	DISK45_ACT_LED_L
A29	DISK45_RX_P	B29	DISK45_TX_N	C29	DISK10_RX_P
A30	DISK45_RX_N	B30	DISK45_TX_P	C30	DISK10_RX_N
A31	DISK10_TX_N	B31	DISK22_RX_P	C31	DISK22_TX_N
A32	DISK10_TX_P	B32	DISK22_RX_N	C32	DISK22_TX_P
A33	DISK34_RX_P	B33	DISK34_TX_N	C33	DISK46_RX_P
A34	DISK34_RX_N	B34	DISK34_TX_P	C34	DISK46_RX_N
A35	DISK46_TX_N	B35	DISK11_RX_P	C35	DISK11_TX_N
A36	DISK46_TX_P	B36	DISK11_RX_N	C36	DISK11_TX_P
A37	DISK34_ACT_LED_L	B37	DISK46_ACT_LED_L	C37	DISK11_ACT_LED_L
A38	DISK47_ACT_LED_L	B38	DISK35_ACT_LED_L	C38	DISK23_ACT_LED_L
A39	DISK23_RX_P	B39	DISK23_TX_N	C39	DISK35_RX_P
A40	DISK23_RX_N	B40	DISK23_TX_P	C40	DISK35_RX_N
A41	DISK35_TX_N	B41	DISK47_RX_P	C41	DISK47_TX_N
A42	DISK35_TX_P	B42	DISK47_RX_N	C42	DISK47_TX_P
A43	PS0_FAN_FAIL_L	B43	PS0_POWEROK	C43	PS1_POWEROK
A44	PS1_FAN_FAIL_L	B44	PS0_PRESENT_L	C44	PS2_POWEROK
A45	PS2_FAN_FAIL_L	B45	PS1_PRESENT_L	C45	PS0_FAIL
A46	PS0_VIN_GOOD_L	B46	PS2_PRESENT_L	C46	PS1_FAIL
A47	PS1_VIN_GOOD_L	B47	PS2_VIN_GOOD_L	C47	PS2_FAIL
A48	PS2_ENABLE_L	B48	SHORT_PIN4	C48	INTRUSION_SW

Table 4 – I/O Card to Disk Backplane Molex Hi-Speed Dock Connector Pin-out

[0056] The I/O Card to disk backplane PowerBlade connector pin-out is set forth below in Table 5. The connector has 10 blades with a 30A limit per blade. There are 20 signals pins. Three blades are used for 12V, giving a 90A capability. Two blades are used for 5V, resulting in a 60A capability.

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
Blade 1							5V_DISK
Blade 2							5V_DISK
Blade 3							GND
Blade 4							GND
Blade 5							GND
A1	FAN4_CTL0	B1	FAN4_CTL0	C1	FAN4_CTL1	D1	FAN4_CTL1
A2	FAN3_CTL0	B2	FAN3_CTL0	C2	FAN3_CTL1	D2	FAN3_CTL1
A3	FAN2_CTL0	B3	FAN2_CTL0	C3	FAN2_CTL1	D3	FAN2_CTL1
A4	FAN1_CTL0	B4	FAN1_CTL0	C4	FAN1_CTL1	D4	FAN1_CTL1
A5	FAN0_CTL0	B5	FAN0_CTL0	C5	FAN0_CTL1	D5	FAN0_CTL1
Blade 6							+12V
Blade 7							GND
Blade 8							+12V
Blade 9							GND
Blade 10							+12V

Table 5 – I/O Card to Disk Backplane PowerBlade Connector Pin-out

[0057] The Mezzanine Connector Pin-outs are set forth below in Tables 6-9.

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
1	PROC0_PCIX0_HTDATA0_P	31	PROC0_PCIX0_HTDATA4_P	61	PCIX0_PROC0_HTCTL_P	91	PCIX0_PROC0_HTCLK0_P
2	PROC0_PCIX0_HTDATA8_P	32	PROC0_PCIX0_HTDATA12_P	62	NO CONNECT	92	PCIX0_PROC0_HTCLK1_P
3	PROC0_PCIX0_HTDATA0_N	33	PROC0_PCIX0_HTDATA4_N	63	PCIX0_PROC0_HTCTL_N	93	PCIX0_PROC0_HTCLK0_N
4	PROC0_PCIX0_HTDATA8_N	34	PROC0_PCIX0_HTDATA12_N	64	NO CONNECT	94	PCIX0_PROC0_HTCLK1_N
5	GND	35	GND	65	GND	95	GND
6	GND	36	GND	66	GND	96	GND
7	PROC0_PCIX0_HTDATA1_P	37	PROC0_PCIX0_HTDATA5_P	67	PCIX0_PROC0_HTDATA7_P	97	PCIX0_PROC0_HTDATA3_P
8	PROC0_PCIX0_HTDATA9_P	38	PROC0_PCIX0_HTDATA13_P	68	PCIX0_PROC0_HTDATA15_P	98	PCIX0_PROC0_HTDATA11_P
9	PROC0_PCIX0_HTDATA1_N	39	PROC0_PCIX0_HTDATA5_N	69	PCIX0_PROC0_HTDATA7_N	99	PCIX0_PROC0_HTDATA3_N
10	PROC0_PCIX0_HTDATA9_N	40	PROC0_PCIX0_HTDATA13_N	70	PCIX0_PROC0_HTDATA15_N	100	PCIX0_PROC0_HTDATA11_N
11	GND	41	GND	71	GND	101	GND
12	GND	42	GND	72	GND	102	GND
13	PROC0_PCIX0_HTDATA2_P	43	PROC0_PCIX0_HTDATA6_P	73	PCIX0_PROC0_HTDATA6_P	103	PCIX0_PROC0_HTDATA2_P
14	PROC0_PCIX0_HTDATA10_P	44	PROC0_PCIX0_HTDATA14_P	74	PCIX0_PROC0_HTDATA14_P	104	PCIX0_PROC0_HTDATA10_P
15	PROC0_PCIX0_HTDATA2_N	45	PROC0_PCIX0_HTDATA6_N	75	PCIX0_PROC0_HTDATA6_N	105	PCIX0_PROC0_HTDATA2_N
16	PROC0_PCIX0_HTDATA10_N	46	PROC0_PCIX0_HTDATA14_N	76	PCIX0_PROC0_HTDATA14_N	106	PCIX0_PROC0_HTDATA10_N
17	GND	47	GND	77	GND	107	GND
18	GND	48	GND	78	GND	108	GND
19	PROC0_PCIX0_HTDATA3_P	49	PROC0_PCIX0_HTDATA7_P	79	PCIX0_PROC0_HTDATA5_P	109	PCIX0_PROC0_HTDATA1_P
20	PROC0_PCIX0_HTDATA11_P	50	PROC0_PCIX0_HTDATA15_P	80	PCIX0_PROC0_HTDATA13_P	110	PCIX0_PROC0_HTDATA9_P
21	PROC0_PCIX0_HTDATA3_N	51	PROC0_PCIX0_HTDATA7_N	81	PCIX0_PROC0_HTDATA5_N	111	PCIX0_PROC0_HTDATA1_N
22	PROC0_PCIX0_HTDATA11_N	52	PROC0_PCIX0_HTDATA15_N	82	PCIX0_PROC0_HTDATA13_N	112	PCIX0_PROC0_HTDATA9_N
23	GND	53	GND	83	GND	113	GND
24	GND	54	GND	84	GND	114	GND
25	PROC0_PCIX0_HTCLK0_P	55	PROC0_PCIX0_HTCTL_P	85	PCIX0_PROC0_HTDATA4_P	115	PCIX0_PROC0_HTDATA0_P
26	PROC0_PCIX0_HTCLK1_P	56	NO CONNECT	86	PCIX0_PROC0_HTDATA12_P	116	PCIX0_PROC0_HTDATA8_P
27	PROC0_PCIX0_HTCLK0_N	57	PROC0_PCIX0_HTCTL_N	87	PCIX0_PROC0_HTDATA4_N	117	PCIX0_PROC0_HTDATA0_N
28	PROC0_PCIX0_HTCLK1_N	58	NO CONNECT	88	PCIX0_PROC0_HTDATA12_N	118	PCIX0_PROC0_HTDATA8_N
29	GND	59	GND	89	GND	119	GND
30	GND	60	GND	90	GND	120	GND

Table 6 – I/O Card to Processor Card Mezzanine Connector Pin-out

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
1	PROC0_PCIX2_HTCTL_N	46	PROC0_PCIX2_HTDATA10_P	91	PCIX2_PROC0_HTDATA4_N	136	P12V
2	NO CONNECT	47	GND	92	PCIX2_PROC0_HTDATA12_N	137	P12V
3	PROC0_PCIX2_HTCTL_P	48	GND	93	PCIX2_PROC0_HTDATA4_P	138	P12V
4	NO CONNECT	49	PROC0_PCIX2_HTDATA1_N	94	PCIX2_PROC0_HTDATA12_P	139	P12V
5	GND	50	PROC0_PCIX2_HTDATA9_N	95	GND	140	P12V
6	GND	51	PROC0_PCIX2_HTDATA1_P	96	GND	141	P12V
7	PROC0_PCIX2_HTDATA7_N	52	PROC0_PCIX2_HTDATA9_P	97	PCIX2_PROC0_HTDATA5_N	142	P12V
8	PROC0_PCIX2_HTDATA15_N	53	GND	98	PCIX2_PROC0_HTDATA13_N	143	P12V
9	PROC0_PCIX2_HTDATA7_P	54	GND	99	PCIX2_PROC0_HTDATA5_P	144	P12V
10	PROC0_PCIX2_HTDATA15_P	55	PROC0_PCIX2_HTDATA0_N	100	PCIX2_PROC0_HTDATA13_P	145	P12V
11	GND	56	PROC0_PCIX2_HTDATA8_P	101	GND	146	P1_2V
12	GND	57	PROC0_PCIX2_HTDATA0_P	102	GND	147	P12V
13	PROC0_PCIX2_HTDATA6_N	58	PROC0_PCIX2_HTDATA8_N	103	PCIX2_PROC0_HTDATA6_N	148	P1_2V
14	PROC0_PCIX2_HTDATA14_N	59	GND	104	PCIX2_PROC0_HTDATA14_N	149	P12V
15	PROC0_PCIX2_HTDATA6_P	60	GND	105	PCIX2_PROC0_HTDATA6_P	150	P1_2V
16	PROC0_PCIX2_HTDATA14_P	61	PCIX2_PROC0_HTDATA0_N	106	PCIX2_PROC0_HTDATA14_P	151	P12V
17	GND	62	PCIX2_PROC0_HTDATA8_N	107	GND	152	P1_2V
18	GND	63	PCIX2_PROC0_HTDATA0_P	108	GND	153	P12V
19	PROC0_PCIX2_HTDATA5_N	64	PCIX2_PROC0_HTDATA8_P	109	PCIX2_PROC0_HTDATA7_N	154	P1_2V
20	PROC0_PCIX2_HTDATA13_N	65	GND	110	PCIX2_PROC0_HTDATA15_N	155	P12V
21	PROC0_PCIX2_HTDATA5_P	66	GND	111	PCIX2_PROC0_HTDATA7_P	156	P1_2V
22	PROC0_PCIX2_HTDATA13_P	67	PCIX2_PROC0_HTDATA1_N	112	PCIX2_PROC0_HTDATA15_P	157	P12V
23	GND	68	PCIX2_PROC0_HTDATA9_N	113	GND	158	P1_2V
24	GND	69	PCIX2_PROC0_HTDATA1_P	114	GND	159	P12V
25	PROC0_PCIX2_HTDATA4_N	70	PCIX2_PROC0_HTDATA9_P	115	PCIX2_PROC0_HTCTL_N	160	P1_2V
26	PROC0_PCIX2_HTDATA12_N	71	GND	116	NO CONNECT	161	P12V
27	PROC0_PCIX2_HTDATA4_P	72	GND	117	PCIX2_PROC0_HTCTL_P	162	P1_2V
28	PROC0_PCIX2_HTDATA12_P	73	PCIX2_PROC0_HTDATA2_N	118	NO CONNECT	163	P12V
29	GND	74	PCIX2_PROC0_HTDATA10_N	119	GND	164	P1_2V
30	GND	75	PCIX2_PROC0_HTDATA2_P	120	GND	165	P12V
31	PROC0_PCIX2_HTCLK0_N	76	PCIX2_PROC0_HTDATA10_P	121	P12V	166	P1_2V
32	PROC0_PCIX2_HTCLK1_N	77	GND	122	P12V	167	P12V
33	PROC0_PCIX2_HTCLK0_P	78	GND	123	P12V	168	P1_2V
34	PROC0_PCIX2_HTCLK1_P	79	PCIX2_PROC0_HTDATA3_N	124	P12V	169	P12V
35	GND	80	PCIX2_PROC0_HTDATA11_N	125	P12V	170	P3_3V
36	GND	81	PCIX2_PROC0_HTDATA3_P	126	P12V	171	P12V
37	PROC0_PCIX2_HTDATA3_N	82	PCIX2_PROC0_HTDATA11_P	127	P12V	172	P3_3V
38	PROC0_PCIX2_HTDATA11_N	83	GND	128	P12V	173	P12V
39	PROC0_PCIX2_HTDATA3_P	84	GND	129	P12V	174	3_3AUX
40	PROC0_PCIX2_HTDATA11_P	85	PCIX2_PROC0_HTCLK0_N	130	P12V	175	P12V
41	GND	86	PCIX2_PROC0_HTCLK1_N	131	P12V	176	3_3AUX
42	GND	87	PCIX2_PROC0_HTCLK0_P	132	P12V	177	P12V
43	PROC0_PCIX2_HTDATA2_N	88	PCIX2_PROC0_HTCLK1_P	133	P12V	178	3_3AUX
44	PROC0_PCIX2_HTDATA10_N	89	GND	134	P12V	179	P12V
45	PROC0_PCIX2_HTDATA2_P	90	GND	135	P12V	180	3_3AUX

Table 7 – I/O Card to Processor Card Mezzanine Connector Pin-out

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
1	PCIX3_PROC1_HTDATA0_P	31	PCIX3_PROC1_HTDATA4_P	61	PROC1_PCIX3_HTCTL_P	91	PROC1_PCIX3_HTCLK0_P
2	PCIX3_PROC1_HTDATA8_P	32	PCIX3_PROC1_HTDATA12_P	62	NO CONNECT	92	PROC1_PCIX3_HTCLK1_P
3	PCIX3_PROC1_HTDATA0_N	33	PCIX3_PROC1_HTDATA4_N	63	PROC1_PCIX3_HTCTL_N	93	PROC1_PCIX3_HTCLK0_N
4	PCIX3_PROC1_HTDATA8_N	34	PCIX3_PROC1_HTDATA12_N	64	NO CONNECT	94	PROC1_PCIX3_HTCLK1_N
5	GND	35	GND	65	GND	95	GND
6	GND	36	GND	66	GND	96	GND
7	PCIX3_PROC1_HTDATA1_P	37	PCIX3_PROC1_HTDATA5_P	67	PROC1_PCIX3_HTDATA7_P	97	PROC1_PCIX3_HTDATA3_P
8	PCIX3_PROC1_HTDATA9_P	38	PCIX3_PROC1_HTDATA13_P	68	PROC1_PCIX3_HTDATA15_P	98	PROC1_PCIX3_HTDATA11_P
9	PCIX3_PROC1_HTDATA1_N	39	PCIX3_PROC1_HTDATA5_N	69	PROC1_PCIX3_HTDATA7_N	99	PROC1_PCIX3_HTDATA3_N
10	PCIX3_PROC1_HTDATA9_N	40	PCIX3_PROC1_HTDATA13_N	70	PROC1_PCIX3_HTDATA15_N	100	PROC1_PCIX3_HTDATA11_N
11	GND	41	GND	71	GND	101	GND
12	GND	42	GND	72	GND	102	GND
13	PCIX3_PROC1_HTDATA2_P	43	PCIX3_PROC1_HTDATA6_P	73	PROC1_PCIX3_HTDATA6_P	103	PROC1_PCIX3_HTDATA2_P
14	PCIX3_PROC1_HTDATA10_P	44	PCIX3_PROC1_HTDATA14_P	74	PROC1_PCIX3_HTDATA14_P	104	PROC1_PCIX3_HTDATA10_P
15	PCIX3_PROC1_HTDATA2_N	45	PCIX3_PROC1_HTDATA6_N	75	PROC1_PCIX3_HTDATA6_N	105	PROC1_PCIX3_HTDATA2_N
16	PCIX3_PROC1_HTDATA10_N	46	PCIX3_PROC1_HTDATA14_N	76	PROC1_PCIX3_HTDATA14_N	106	PROC1_PCIX3_HTDATA10_N
17	GND	47	GND	77	GND	107	GND
18	GND	48	GND	78	GND	108	GND
19	PCIX3_PROC1_HTDATA3_P	49	PCIX3_PROC1_HTDATA7_P	79	PROC1_PCIX3_HTDATA5_P	109	PROC1_PCIX3_HTDATA1_P
20	PCIX3_PROC1_HTDATA11_P	50	PCIX3_PROC1_HTDATA15_P	80	PROC1_PCIX3_HTDATA13_P	110	PROC1_PCIX3_HTDATA9_P
21	PCIX3_PROC1_HTDATA3_N	51	PCIX3_PROC1_HTDATA7_N	81	PROC1_PCIX3_HTDATA5_N	111	PROC1_PCIX3_HTDATA1_N
22	PCIX3_PROC1_HTDATA11_N	52	PCIX3_PROC1_HTDATA15_N	82	PROC1_PCIX3_HTDATA13_N	112	PROC1_PCIX3_HTDATA9_N
23	GND	53	GND	83	GND	113	GND
24	GND	54	GND	84	GND	114	GND
25	PCIX3_PROC1_HTCLK0_P	55	PCIX3_PROC1_HTCTL_P	85	PROC1_PCIX3_HTDATA4_P	115	PROC1_PCIX3_HTDATA0_P
26	PCIX3_PROC1_HTCLK1_P	56	NO CONNECT	86	PROC1_PCIX3_HTDATA12_P	116	PROC1_PCIX3_HTDATA8_P
27	PCIX3_PROC1_HTCLK0_N	57	PCIX3_PROC1_HTCTL_N	87	PROC1_PCIX3_HTDATA4_N	117	PROC1_PCIX3_HTDATA0_N
28	PCIX3_PROC1_HTCLK1_N	58	NO CONNECT	88	PROC1_PCIX3_HTDATA12_N	118	PROC1_PCIX3_HTDATA8_N
29	GND	59	GND	89	GND	119	GND
30	GND	60	GND	90	GND	120	GND

Table 8 – I/O Card to Processor Card Mezzanine Connector Pin-out

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
1	PCIX1_PROC1_HTCTL_N	46	PCIX1_PROC1_HTDATA10_P	91	PROC1_PCIX1_HTDATA4_N	136	SP_HDT_ENABLE_L
2	NO CONNECT	47	GND	92	PROC1_PCIX1_HTDATA12_N	137	GND
3	PCIX1_PROC1_HTCTL_P	48	GND	93	PROC1_PCIX1_HTDATA4_P	138	GND
4	NO CONNECT	49	PCIX1_PROC1_HTDATA1_N	94	PROC1_PCIX1_HTDATA12_P	139	PROC0_PRESENT
5	GND	50	PCIX1_PROC1_HTDATA9_N	95	GND	140	DDR_A_POWERGOOD_L
6	GND	51	PCIX1_PROC1_HTDATA1_P	96	GND	141	PROC1_PRESENT
7	PCIX1_PROC1_HTDATA7_N	52	PCIX1_PROC1_HTDATA9_P	97	PROC1_PCIX1_HTDATA5_N	142	DDR_B_POWERGOOD_L
8	PCIX1_PROC1_HTDATA15_N	53	GND	98	PROC1_PCIX1_HTDATA13_N	143	HDT_LDTRST_L
9	PCIX1_PROC1_HTDATA7_P	54	GND	99	PROC1_PCIX1_HTDATA5_P	144	GND
10	PCIX1_PROC1_HTDATA15_P	55	PCIX1_PROC1_HTDATA0_N	100	PROC1_PCIX1_HTDATA13_P	145	PROC0_LDTRST_L
11	GND	56	PCIX1_PROC1_HTDATA8_N	101	GND	146	PROC1_LDTRST_L
12	GND	57	PCIX1_PROC1_HTDATA0_P	102	GND	147	PROC0_LDTSTOP_L
13	PCIX1_PROC1_HTDATA6_N	58	PCIX1_PROC1_HTDATA8_P	103	PROC1_PCIX1_HTDATA6_N	148	PROC1_LDTSTOP_L
14	PCIX1_PROC1_HTDATA14_N	59	GND	104	PROC1_PCIX1_HTDATA14_N	149	GND
15	PCIX1_PROC1_HTDATA6_P	60	GND	105	PROC1_PCIX1_HTDATA6_P	150	GND
16	PCIX1_PROC1_HTDATA14_P	61	PROC1_PCIX1_HTDATA0_N	106	PROC1_PCIX1_HTDATA14_P	151	PROC_PWROK
17	GND	62	PROC1_PCIX1_HTDATA8_N	107	GND	152	PROC0_CORE_ENABLE
18	GND	63	PROC1_PCIX1_HTDATA0_P	108	GND	153	SP_HDT_TRST_L
19	PCIX1_PROC1_HTDATA5_N	64	PROC1_PCIX1_HTDATA8_P	109	PROC1_PCIX1_HTDATA7_N	154	PROC1_CORE_ENABLE
20	PCIX1_PROC1_HTDATA13_N	65	GND	110	PROC1_PCIX1_HTDATA15_N	155	GND
21	PCIX1_PROC1_HTDATA5_P	66	GND	111	PROC1_PCIX1_HTDATA7_P	156	GND
22	PCIX1_PROC1_HTDATA13_P	67	PROC1_PCIX1_HTDATA1_N	112	PROC1_PCIX1_HTDATA15_P	157	SP_HDT_TCK
23	GND	68	PROC1_PCIX1_HTDATA9_N	113	GND	158	DDR_A_ENABLE
24	GND	69	PROC1_PCIX1_HTDATA1_P	114	GND	159	SP_HDT_TMS
25	PCIX1_PROC1_HTDATA4_N	70	PROC1_PCIX1_HTDATA9_P	115	PROC1_PCIX1_HTCTL_N	160	DDR_B_ENABLE
26	PCIX1_PROC1_HTDATA12_N	71	GND	116	NO CONNECT	161	GND
27	PCIX1_PROC1_HTDATA4_P	72	GND	117	PROC1_PCIX1_HTCTL_P	162	GND
28	PCIX1_PROC1_HTDATA12_P	73	PROC1_PCIX1_HTDATA2_N	118	NO CONNECT	163	SP_HDT_TDI
29	GND	74	PROC1_PCIX1_HTDATA10_N	119	GND	164	P0_VRM_PRESENT_L
30	GND	75	PROC1_PCIX1_HTDATA2_P	120	GND	165	PROC0_PROC1_TDX
31	PCIX1_PROC1_HTCLK0_N	76	PROC1_PCIX1_HTDATA10_P	121	PROC0_I2C_CLK	166	P1_VRM_PRESENT_L
32	PCIX1_PROC1_HTCLK1_N	77	GND	122	THERM_L	167	GND
33	PCIX1_PROC1_HTCLK0_P	78	GND	123	PROC0_I2C_DAT	168	GND
34	PCIX1_PROC1_HTCLK1_P	79	PROC1_PCIX1_HTDATA3_N	124	SYSMON_INT_L	169	SP_PROC0_DBREQ_L
35	GND	80	PROC1_PCIX1_HTDATA11_N	125	GND	170	PROC0_CLK_P
36	GND	81	PROC1_PCIX1_HTDATA3_P	126	GND	171	PROC0_DBRDY
37	PCIX1_PROC1_HTDATA3_N	82	PROC1_PCIX1_HTDATA11_P	127	PROC1_I2C_CLK	172	PROC0_CLK_N
38	PCIX1_PROC1_HTDATA11_N	83	GND	128	P0_CORE_POWERGOOD	173	GND
39	PCIX1_PROC1_HTDATA3_P	84	GND	129	PROC1_I2C_DAT	174	GND
40	PCIX1_PROC1_HTDATA11_P	85	PROC1_PCIX1_HTCLK0_N	130	P1_CORE_POWERGOOD	175	V_RTC_BATT
41	GND	86	PROC1_PCIX1_HTCLK1_N	131	GND	176	PROC1_CLK_P
42	GND	87	PROC1_PCIX1_HTCLK0_P	132	GND	177	MEZZ_SENSE_L
43	PCIX1_PROC1_HTDATA2_N	88	PROC1_PCIX1_HTCLK1_P	133	SP_I2C_CLK	178	PROC1_CLK_N
44	PCIX1_PROC1_HTDATA10_N	89	GND	134	THERMTRIP_L	179	GND
45	PCIX1_PROC1_HTDATA2_P	90	GND	135	SP_I2C_DAT	180	GND

Table 9– I/O Card to Processor Card Mezzanine Connector Pin-out

[0058] Figure 10 shows the face plate **100** for the Controller Assembly. Three printed circuit boards (PCBs) are included in this assembly and all of the other assemblies/field replaceable units plug into these PCBs. The three PCBs are the disk backplane, the power backplane, and the indicator board. The disk backplane connects to the System Controller Assembly, the hard drives, and the fan trays. The disk backplane also includes the front USB ports. The power backplane connects to the three power supplies which provide power to the disk backplane. The disk backplane serves as the central point for the chassis. All field replaceable units plug into the disk backplane.

[0059] The Power Backplane-to-Disk Backplane Connector Pin-out is set forth below in Table 10. The connector has 10 blades with a 30A limit per blade. There are 24 signals pins. Five blades are used for 12V, giving a 150A capability.

Signal Name	Signal Type	Pin Count
+12V	Power	5 blades
I2C (SCL, SDA)	Bi-directional data	2
Intrusion Detection	Input	1
Enable	Input	4 (1 reserved)
Fail	Output	4 (1 reserved)
Presence Detect	Input	4 (1 reserved)
Front Panel LEDs	Input	4
Spare		4
Ground	Ground	5 blades

Table 10 – Power Backplane to Disk Backplane Connector Pin-out

[0060] The Power Supply Connector Pin-out is set forth below in Table 11.

Pin #	Pin Name	Description
P1	12V	12V Power Output (Blade)
P2	12V	12V Power Output (Blade)
A1	SCL	EEPROM Serial Clock Input
B1	SDA	EEPROM Serial Data I/O
C1	A0	EEPROM LSB Address Input
D1	12VRS	12V Remote Sense
A2	A1	EEPROM Address Bit 1 Input
B2	CS	12V Current Share
C2	PF	Power Fail

Pin #	Pin Name	Description
D2	12VT	12V Test
A3	NC	No Connect
B3	NC	No Connect
C3	NC	No Connect
D3	NC	No Connect
A4	NC	No Connect
B4	NC	No Connect
C4	NC	No Connect
D4	NC	No Connect
A5	NC	No Connect
B5	ID0	Power Supply ID Bit 0
C5	ID1	Power Supply ID Bit 1
D5	ID2	Power Supply ID Bit 2
A6	NC	No Connect
B6	NC	No Connect
C6	PCTL	Power Control (short pin – 0.170")
D6	12VRRS	12V Return Remote Sense
7	12VR	Main Power Return (Blade)
8	12VR	Main Power Return (Blade)

Table 11 – Power Supply Output Connector Pin-out

[0061] The Controller Assembly includes an Inter-IC Communication bus (I2C), which is a 2-pin serial bus used to control some of the basic system management features. The I/O Board and Service Processor include EEPROMs, fan controllers, power supply monitors, etc., which are used to monitor the health and status of the system. In some cases, such as temperature, a separate interrupt immediately alerts the processors in case of a problem.

[0062] The CPLD, located on the I/O Board, handles Battery Backup failover. This is done to enable the quickest transition to battery power upon loss of AC power. The CPLD detects the type of unit in each power bay. Power bays 0 and 1 are power supplies. Power bay 2 can either be a power supply or a battery backup unit. The battery backup unit may be, as an example, an uninterruptible power supply (UPS) unit. A battery backup unit is indicated by assertion of the PS2_BATT_L signal (driven low). This signal is connected to Pin D4 of the power supply connectors and is grounded inside the battery backup unit.

[0063] When power-on sequence is initiated, the power supplies are enabled and the battery is not enabled. When all power supplies indicate failure, the CPLD will assert the ENABLE signal to the battery. The ENABLE signals going to the power supplies remain asserted. The Service Processor detects the switch to battery power and signals the operating system (OS) to power down after a given interval. During that interval, the CPLD will monitor the PS signals. If a power supply recovers and reasserts its POWEROK signal – either AC power is restored or a new power supply is installed – the CPLD disables the battery.

[0064] The Service Processor detects the failover to battery power and notifies the OS. The SP detects the failover to battery power by observing the POWEROK signal of the battery. If this is ever asserted, that means the system has switched to battery power. The SP waits for a given interval to determine whether AC power is restored or if a new power supply is inserted.

If the time on battery power exceeds the given interval, the SP signals the OS to start a rapid shutdown.

[0065] Also, the SP logs the event. Thus, if too many power failure events occur, the SP can flag a problem. The SP also tracks the amount of time that the battery is powering the system, so that the battery can be replaced at the appropriate time. This information is stored in the EEPROM of the BBU. The OS has a rapid shutdown routine triggered by the SP notification. This shuts the system down within 4 minutes.

[0066] Connector pin-outs for various SunFire x4500 system connectors are set forth below. The USB connector is shown in figure 16 and the pin-outs are shown below in table 12.

Pin #	Pin Name	Description
1	+5V	+5V Supply
2	Data-	Negative side of differential pair for data
3	Data+	Positive side of differential pair for data
4	Gnd	Ground

Table 12 – USB connector pin-out

[0067] The Serial connector is shown in figure 17 and the pin-outs are shown below in table 13.

Pin #	Pin Name	Description
1	RTS	Ready To Send
2	DTR	Data Terminal Ready
3	TXD	Transmit Data
4	GND	Ground
5	GND	Ground
6	RXD	Receive Data
7	DSR	Data Set Ready
8	CTS	Clear To Send

Table 13 – Serial connector pin-out

[0068] The 10/100BaseT connector is shown in figure 18 and the pin-outs are shown below in table 14.

Pin #	Pin Name	Description
1	TX+	Positive Side of Transmit Data
2	TX-	Negative Side of Transmit Data
3	RX+	Positive Side of Receive Data

4	NC	No Connect
5	NC	No Connect
6	RX-	Negative Side of Receive Data
7	NC	No Connect
8	NC	No Connect

Table 14 – 1/100BaseT Connector pin-out

[0069] The 10/100/1000BaseT connector is shown in figure 19 and the pin-outs are shown below in table 15.

Pin #	Pin Name	Description
1	TP0+	Positive Side of Data Pair 0
2	TP0-	Negative Side of Data Pair 0
3	TP1+	Positive Side of Data Pair 1
4	TP2+	Positive Side of Data Pair 2
5	TP2-	Negative Side of Data Pair 2
6	TP1-	Negative Side of Data Pair 1
7	TP3+	Positive Side of Data Pair 3
8	TP3-	Negative Side of Data Pair 3

Table 15 – 10/100/1000BaseT Connector pin-out

[0070] The S-ATA connector is shown in figure 20 and the pin-outs are shown below in table 16.

Pin-out Table			
Signal Segment Key			
Signal Segment	S1	Gnd	2nd mate
	S2	TX+	Transmit from PHY to
	S3	TX-	hard drive
	S4	Gnd	2nd mate
	S5	RX-	Receive from hard
	S6	RX+	drive to PHY
	S7	Gnd	2nd mate
Signal Segment "L"			
Central Connector Polarizer			
Power Segment "L"			
Power Segment	P1	3.3V	Not Supported
	P2	3.3V	Not Supported
	P3	3.3V	Not Supported
	P4	Gnd	1st mate
	P5	Gnd	2nd mate
	P6	Gnd	2nd mate
	P7	5.0V	Pre-charge, 2nd mate
	P8	5.0V	
	P9	5.0V	
	P10	Gnd	2nd mate
	P11	Reserved	No connect
	P12	Gnd	1st mate
	P13	12.0V	Pre-charge, 2nd mate
	P14	12.0V	
	P15	12.0V	
Power Segment Key			

Table 16 – S-ATA connector pin-out

[0071] The VGA connector is shown in figure 21 and the pin-outs are shown below in table 17.

Pin #	Pin Name	Description
1	RED	Red Video
2	GRN	Green Video
3	BLU	Blue Video
4	NC	No Connect
5	GND	Ground
6	R_GND	Red Video Return (Ground)
7	G_GND	Green Video Return (Ground)
8	B_GND	Blue Video Return (Ground)
9	KEY	No Pin
10	S_GND	Sync Return (Ground)
11	NC	No Connect
12	ID1	Monitor ID1
13	HSYNC	Horizontal Sync
14	VSYNC	Vertical Sync
15	ID2	Monitor ID2

Table 17 – VGA connector pin-out

[0072] While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

CLAIMS

What is claimed is:

1. A server, comprising:
a printed circuit board (PCB) disposed along an inside surface of the server, the PCB having a plurality of connectors adapted to be connected to a plurality of top-loading storage devices; and
a controller assembly operatively connected to the PCB.

2. The server of claim 1, wherein the controller assembly is operatively connected to the PCB from a rear side of the PCB.

3. The server of claim 1, wherein the PCB is a backplane.

4. The server of claim 1, wherein the plurality of top-loading storage devices comprises 48 hard disks.

5. The server of claim 4, wherein the 48 hard disks are disposable in a 12 x 4 arrangement.

6. The server of claim 1, wherein the controller assembly comprises a general purpose architecture capable of running at least one general purpose application.

7. The server of claim 1, wherein the controller assembly includes at least one PCI expansion slot.

8. The server of claim 7, wherein the at least one PCI expansion slot is one of a PCI-X expansion slot and a PCI-Express expansion slot.

9. The server of claim 1, further comprising:
a plurality of redundant cooling units disposed along a first side

portion of the server.

10. The server of claim 9, wherein at least one of the plurality of redundant cooling units is arranged to direct air into the server.

11. The server of claim 9, wherein the plurality of redundant cooling units comprises two rows of fans.

12. The server of claim 1, further comprising:

an integrated battery arranged to store power for saving data in a main memory to at least one of the plurality of top-loading storage devices.

13. The server of claim 3, wherein the backplane is disposed along an inside bottom surface of the server.

14. An apparatus, comprising:

a chassis;

a printed circuit board (PCB) having a first connector connectable to a second connector integral with a storage device insertable from a top portion of the chassis; and

a controller assembly operatively connectable to a rear side of the PCB, the controller assembly being accessible from a rear side of the chassis.

15. The apparatus of claim 14, wherein the PCB is operatively connectable to 48 storage devices .

16. The apparatus of claim 15, wherein the 48 storage devices are operatively connectable to the PCB in a 12 x 4 configuration.

17. The apparatus of claim 14, wherein the controller assembly comprises a general purpose architecture capable of running at least one general purpose application.

18. The apparatus of claim 14, wherein the controller assembly includes at least one PCI expansion slot.

19. The apparatus of claim 18, wherein the at least one PCI expansion slot is one of a PCI-X expansion slot and a PCI-Express expansion slot.

20. The apparatus of claim 14, wherein the controller assembly includes a CPU board assembly.

21. The apparatus of claim 14, further comprising:

a plurality of rows of cooling units disposed along a front portion of the chassis.

22. The apparatus of claim 21, wherein at least one of the plurality of rows of cooling units is arranged to direct air into the chassis.

23. The apparatus of claim 14, further comprising:

a disk carrier arranged to at least partially house the storage device..

24. The apparatus of claim 14, wherein the storage device is one of a SATA disk and a SAS disk.

25. The apparatus of claim 14, further comprising:

a battery backup unit operatively connected in an interior region of the chassis.

26. The apparatus of Claim 25, wherein the battery backup unit is an uninterruptible power supply.

27. A rackmount storage server, comprising:

a backplane;

top-loading hard disks each having a native connector pluggable into the backplane; and

a controller assembly operatively connected to the backplane from a rear side of the backplane.

28. The rackmount storage server of claim 27, wherein the backplane is a passive backplane.

29. The rackmount storage server of claim 27, wherein the top-loading hard disks are arranged in the rackmount storage server in 4 rows of 12 disks each.

30. The rackmount storage server of claim 27, wherein the controller assembly comprises a general purpose server architecture arranged to run at least one general purpose application.

31. The rackmount storage server of claim 27, wherein the controller assembly includes one of a PCI-X expansion slot and a PCI-Express expansion slot.

32. The rackmount storage server of claim 27, further comprising:

redundant fan units disposed along a front portion of the rackmount storage server and arranged to direct air into the rackmount storage server.

33. The rackmount storage server of claim 27, further comprising:

an integrated UPS battery arranged to store power for saving data from a main memory to at least one of the top-loading hard disks.

34. The rackmount storage server of claim 27, wherein at least one of the top-loading hard disks comprises one of a SATA disk and a SAS disk.

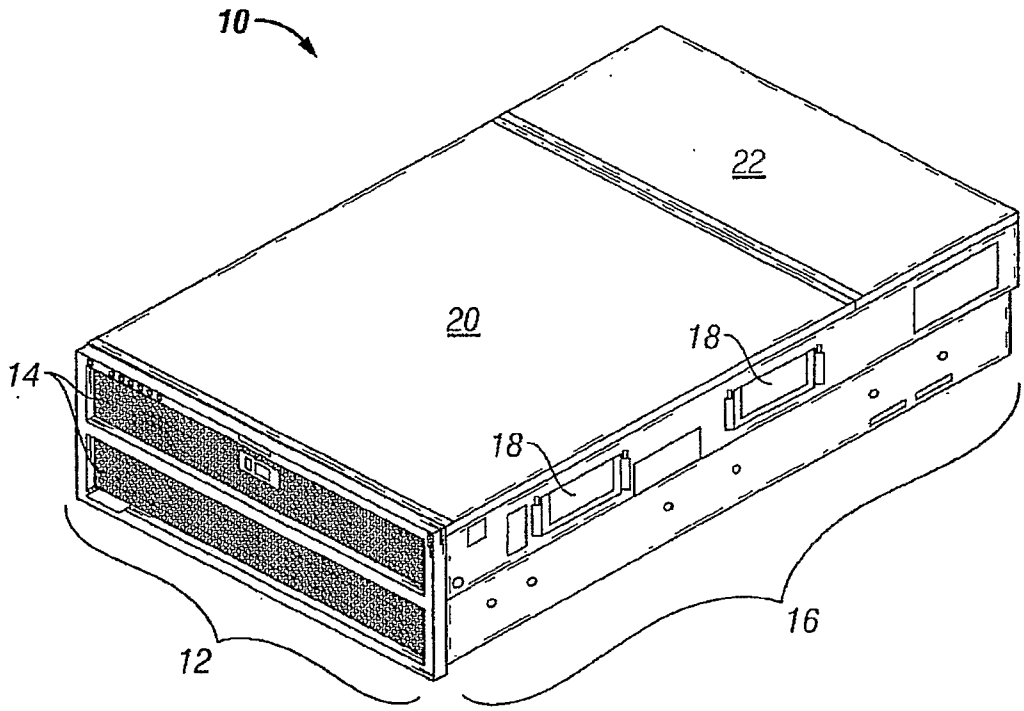


FIG. 1

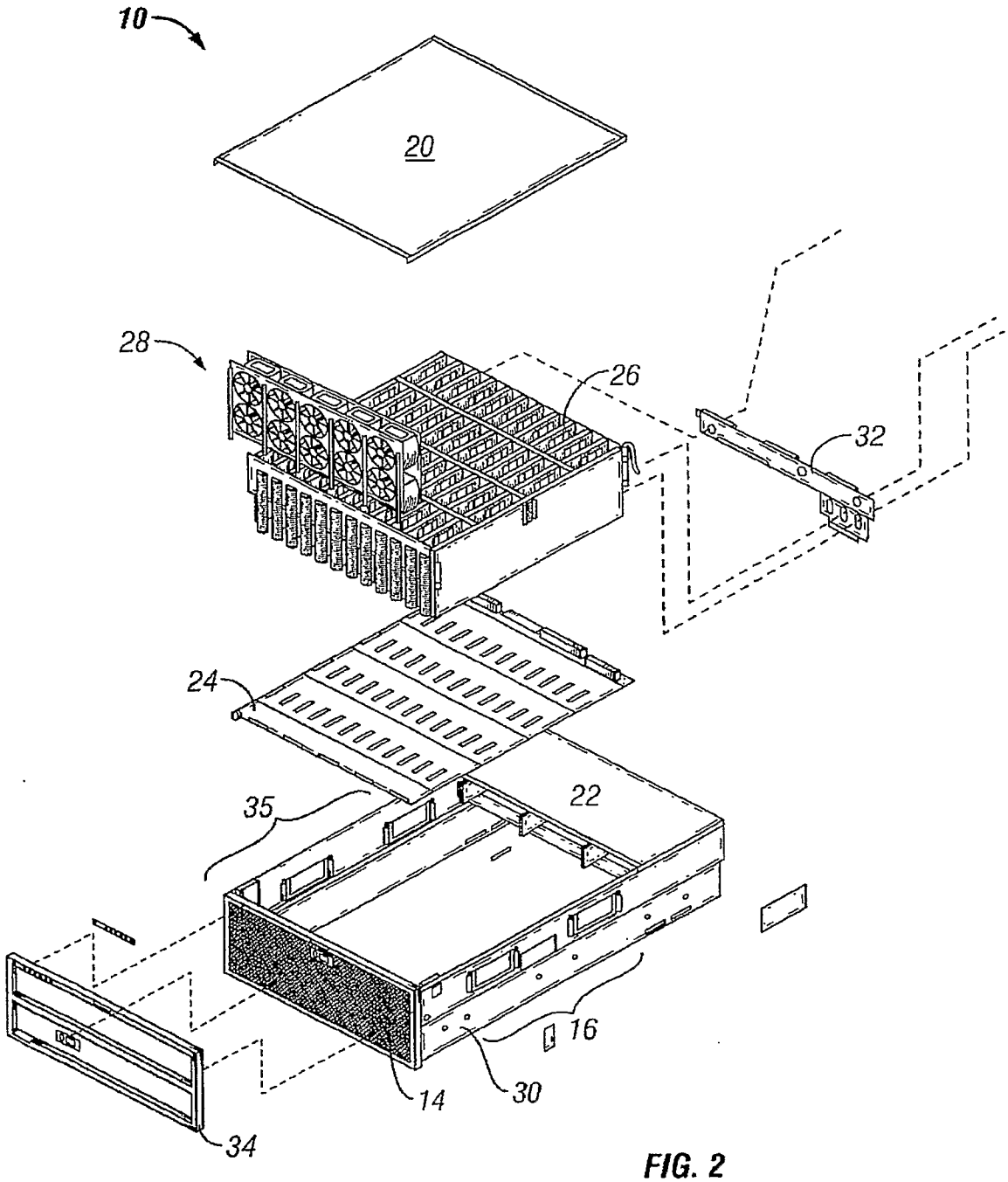


FIG. 2

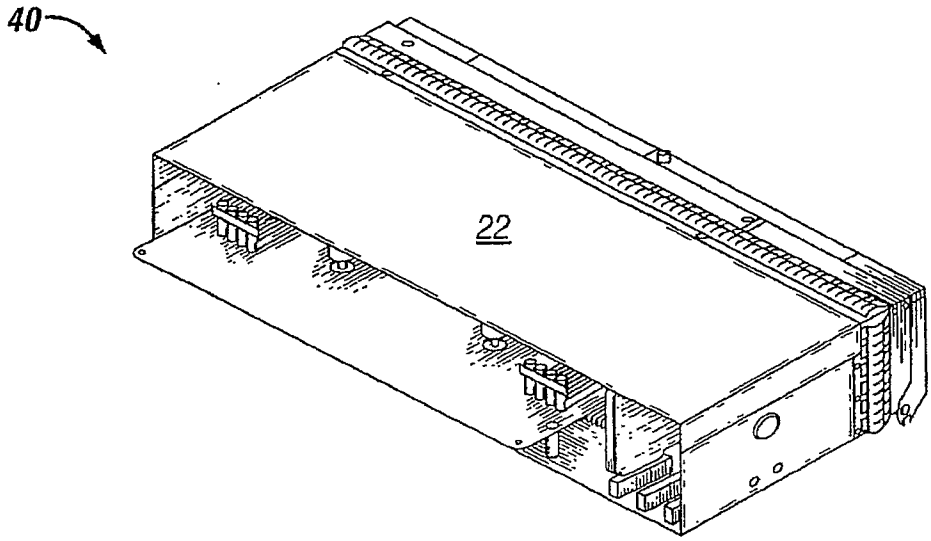


FIG. 3

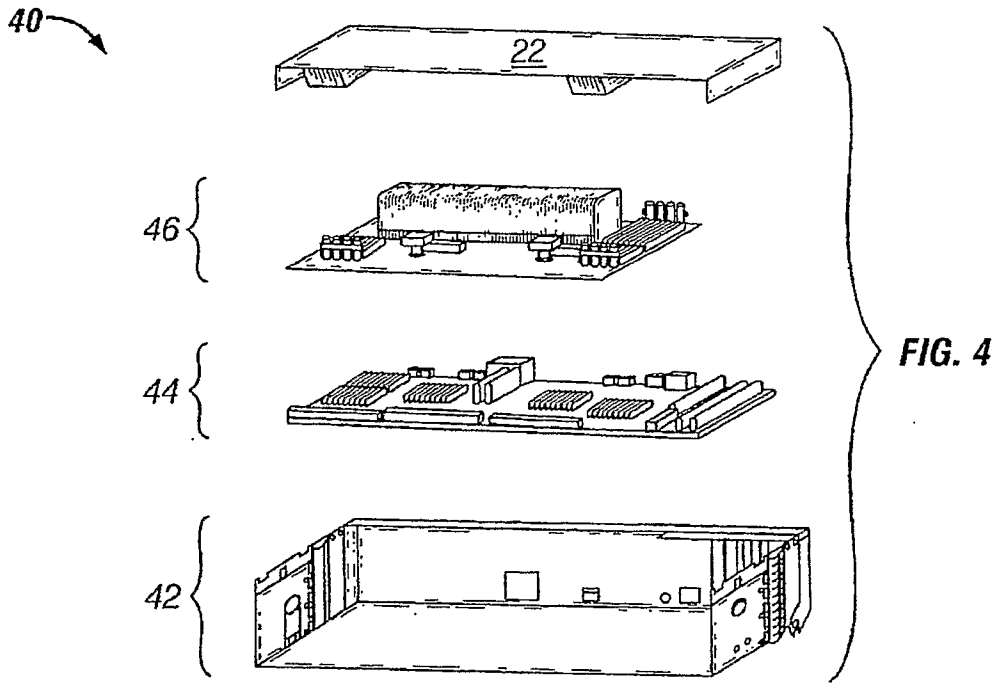
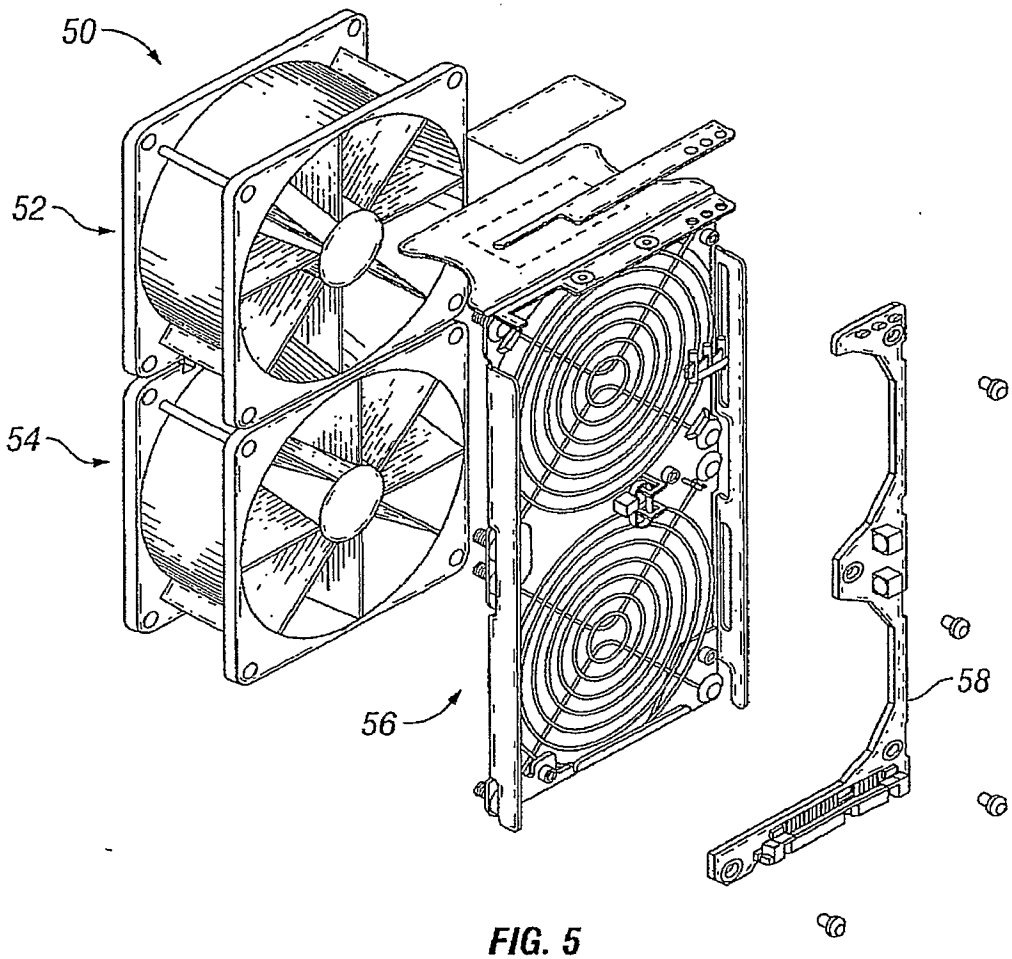


FIG. 4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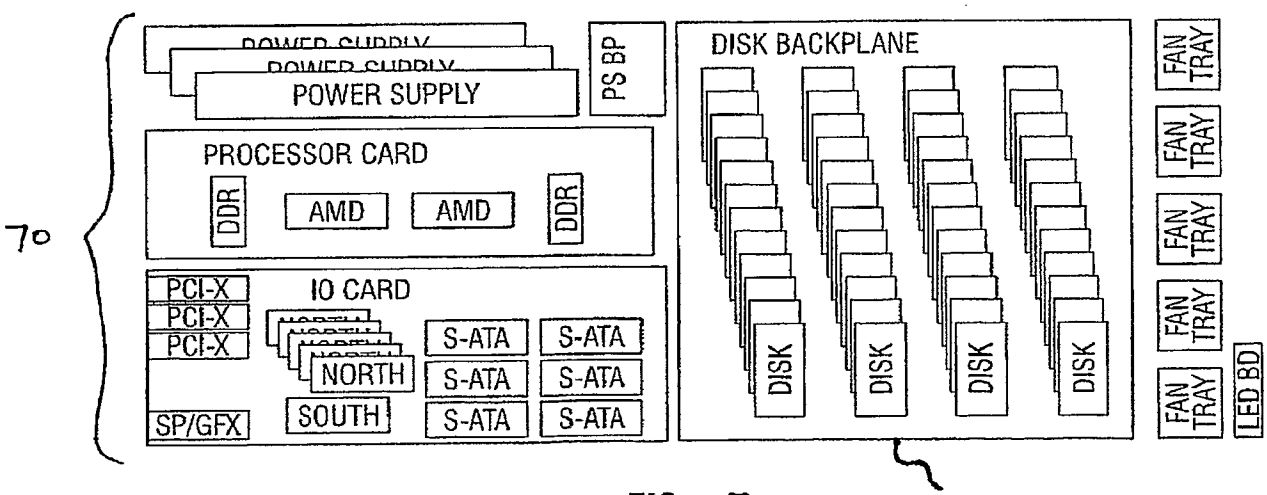
52
54
56
58

FIG. 5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PS BP
PROCESSOR CARD
DDR
AMD
AMD
DDR
PCI-X
PCI-X
PCI-X
IO CARD
NORTH
SOUTH
S-ATA
S-ATA
S-ATA
S-ATA
S-ATA
S-ATA
SP/GFX
DISK BACKPLANE
DISK
DISK
DISK
DISK
FAN TRAY
FAN TRAY
FAN TRAY
FAN TRAY
FAN TRAY
LED BD
70
71

FIG. 7

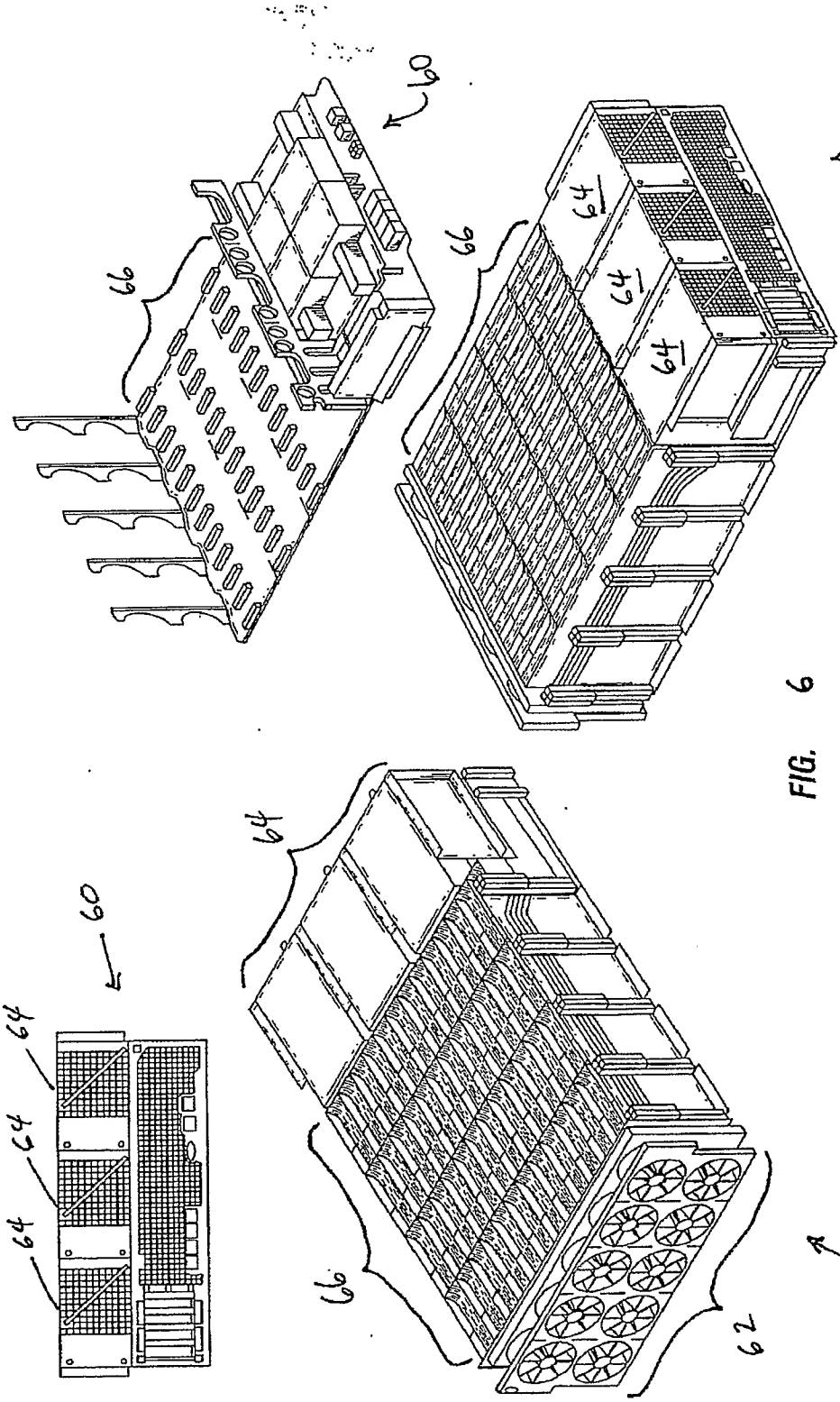

FIG. 6

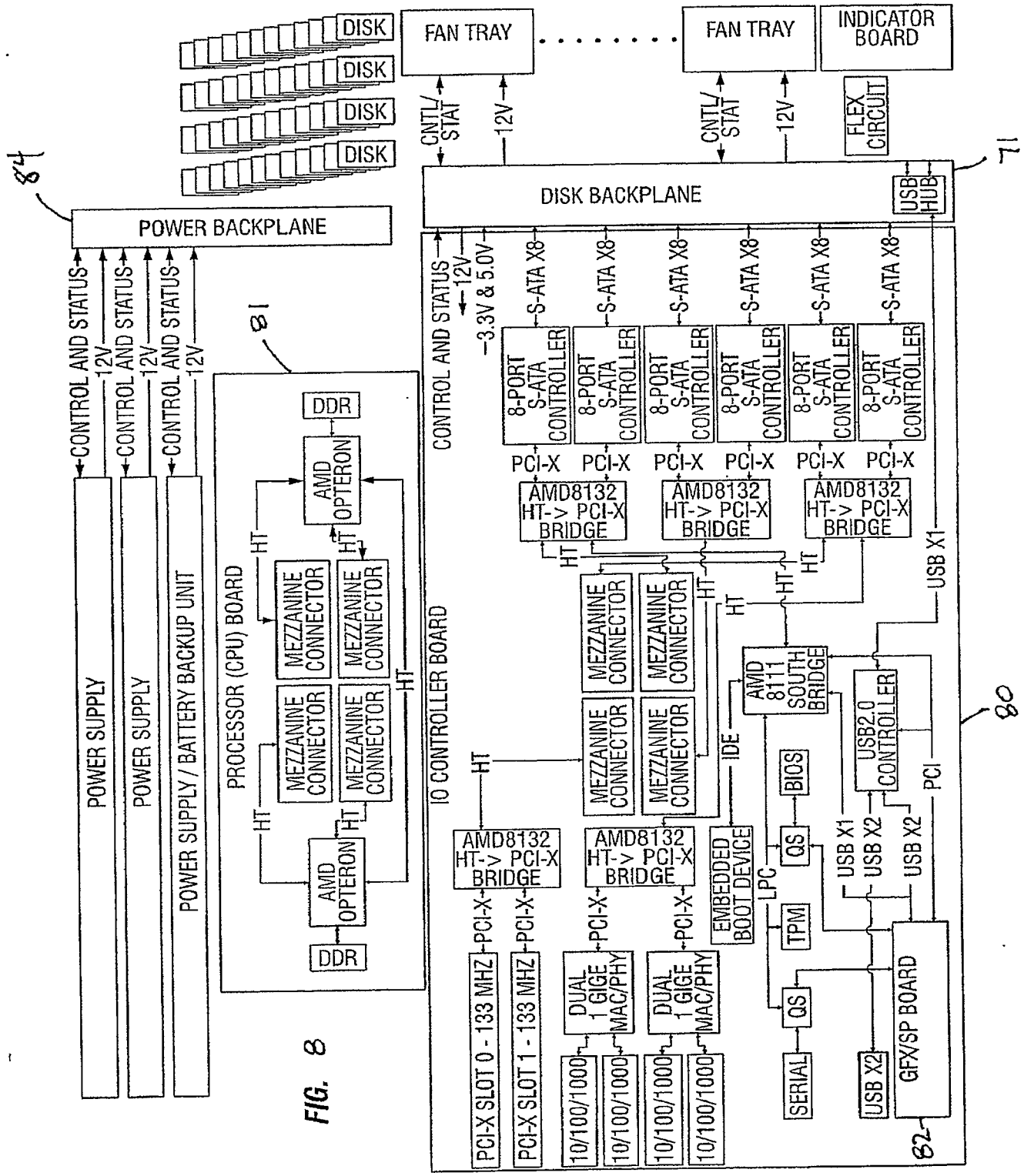
DISK
DISK
DISK
DISK
FAN TRAY
FAN TRAY
INDICATOR BOARD
CNTL/STAT
12V
CNTL/STAT
12V
FLEX CIRCUIT
84
POWER BACKPLANE
DISK BACKPLANE
USB HUB
71
CONTROL AND STATUS
12V
CONTROL AND STATUS
12V
CONTROL AND STATUS
12V
CONTROL AND STATUS
12V
-3.3V & 5.0V
S-ATA X8
S-ATA X8
S-ATA X8
S-ATA X8
S-ATA X8
S-ATA X8
8-PORT S-ATA CONTROLLER
8-PORT S-ATA CONTROLLER
8-PORT S-ATA CONTROLLER
8-PORT S-ATA CONTROLLER
8-PORT S-ATA CONTROLLER
8-PORT S-ATA CONTROLLER
PCI-X
PCI-X
PCI-X
PCI-X
PCI-X
PCI-X
AMD8132 HT-> PCI-X BRIDGE
AMD8132 HT-> PCI-X BRIDGE
AMD8132 HT-> PCI-X BRIDGE
POWER SUPPLY
POWER SUPPLY
POWER SUPPLY / BATTERY BACKUP UNIT
81
PROCESSOR (CPU) BOARD
DDR
AMD OPTERON
HT
MEZZANINE CONNECTOR
MEZZANINE CONNECTOR
MEZZANINE CONNECTOR
MEZZANINE CONNECTOR
HT
AMD OPTERON
DDR
IO CONTROLLER BOARD
HT
MEZZANINE CONNECTOR
MEZZANINE CONNECTOR
MEZZANINE CONNECTOR
MEZZANINE CONNECTOR
HT
HT
HT
AMD 8111 SOUTH BRIDGE
USB X1
USB2.0 CONTROLLER
PCI
80
IDE
BIOS
AMD8132 HT-> PCI-X BRIDGE
AMD8132 HT-> PCI-X BRIDGE
EMBEDDED BOOT DEVICE
LPC
QS
USB X1
USB X2
USB X2
PCI-X
PCI-X
PCI-X
PCI-X
TPM
QS
PCI-X SLOT 0 - 133 MHZ
PCI-X SLOT 1 - 133 MHZ
DUAL 1 GIGE MAC/PHY
DUAL 1 GIGE MAC/PHY
SERIAL
USB X2
GFX/SP BOARD
10/100/1000
10/100/1000
10/100/1000
10/100/1000
82

FIG. 8

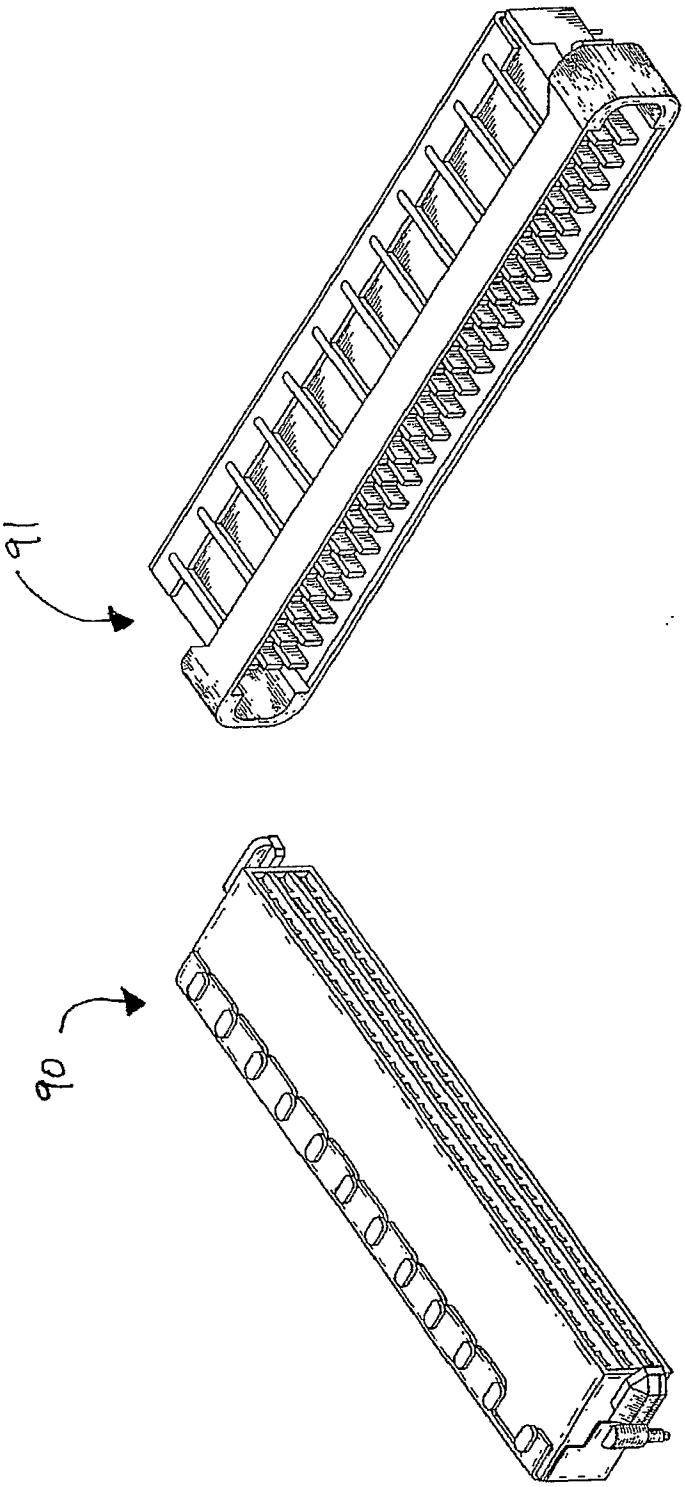

FIG. 9

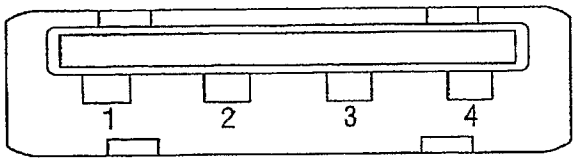

FIG. 11

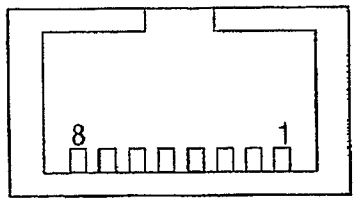

FIG. 12

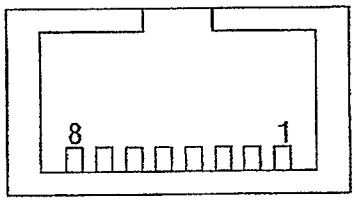

FIG. 13

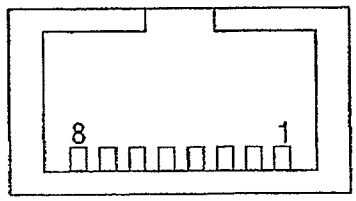

FIG. 14

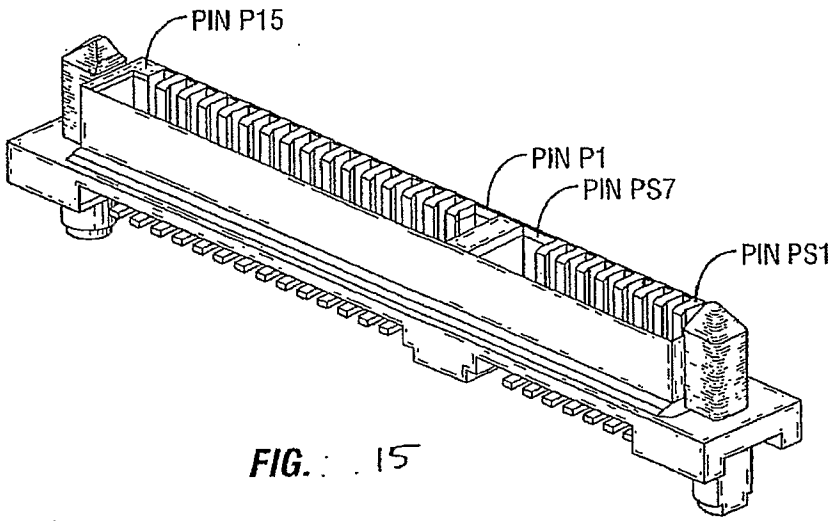

FIG. 15

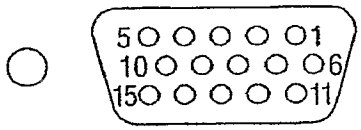

FIG. 16

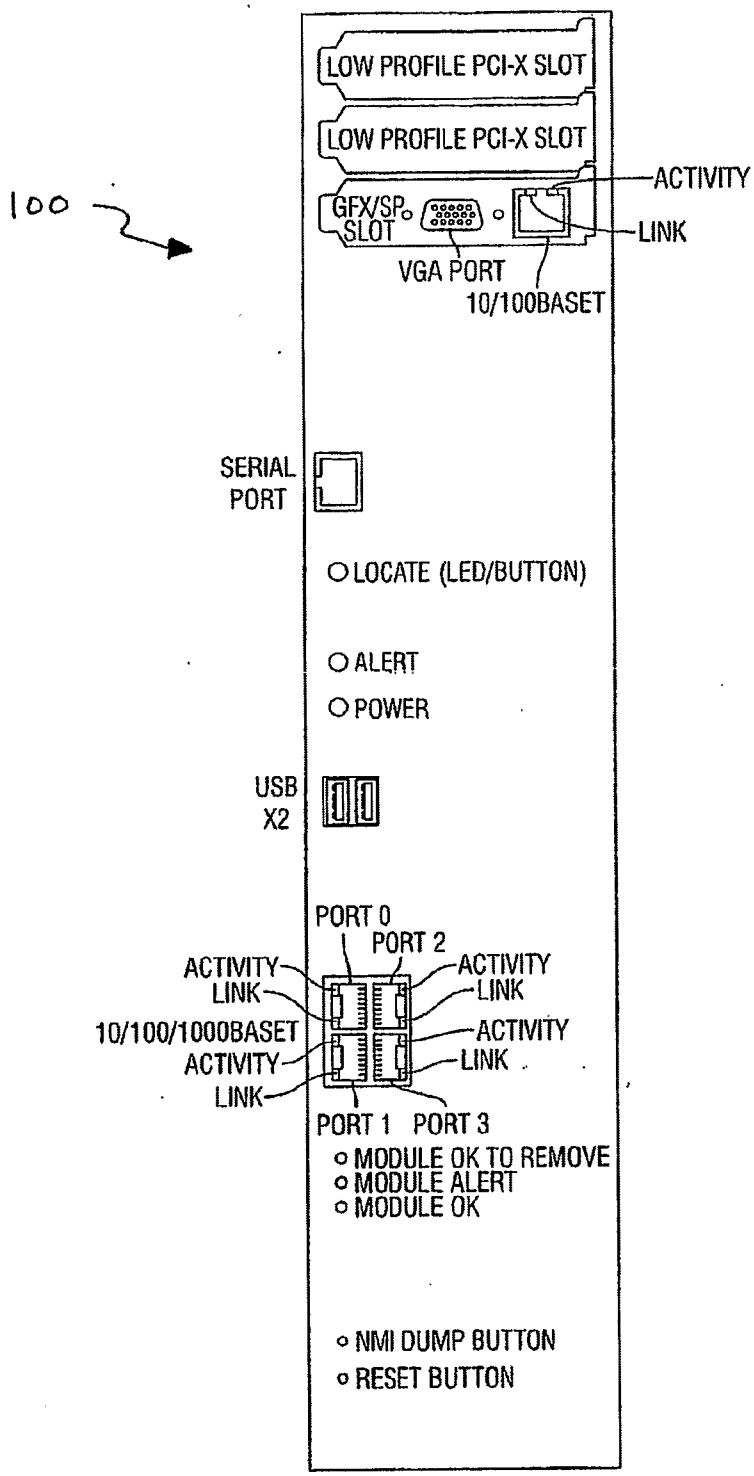
100
LOW PROFILE PCI-X SLOT
LOW PROFILE PCI-X SLOT
ACTIVITY
GFX/SP SLOT
LINK
VGA PORT
10/100BASET
SERIAL PORT
LOCATE (LED/BUTTON)
ALERT
POWER
USB X2
PORT 0
PORT 2
ACTIVITY
LINK
ACTIVITY
LINK
10/100/1000BASET
ACTIVITY
LINK
ACTIVITY
LINK
PORT 1
PORT 3
MODULE OK TO REMOVE
MODULE ALERT
MODULE OK
NMI DUMP BUTTON
RESET BUTTON

FIG. 10