



# **VT8231**

## **South Bridge**

**PC99 COMPLIANT**

**INTEGRATED SUPER-I/O (FDC, LPT, COM, AND FIR),  
INTEGRATED FAST ETHERNET, LPC, ISA / LPC BIOS ROM,  
INTEGRATED SOUNDBLASTER PRO / MULTICHANNEL  
DIRECTSOUND AC97 AUDIO AND MC97 MODEM INTERFACE,  
ULTRADMA-33/66/100 MASTER MODE EIDE CONTROLLER,  
4 PORT USB CONTROLLER, KEYBOARD CONTROLLER, RTC,  
SERIAL IRQ, SMBUS, SERIAL EEPROM,  
PLUG AND PLAY, ACPI, ENHANCED POWER MANAGEMENT,  
TEMPERATURE, VOLTAGE, AND FAN-SPEED MONITORING**

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**VIA TECHNOLOGIES, INC.**

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## REVISION HISTORY

| Document Release | Date     | Revision                                                                                                                                                                                                                                                                                                                | Initials |
|------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Revision 0.4     | 9/17/99  | Initial release based on 82C686A "Super South" Data Sheet revision 1.42<br>Updated feature bullets, document title, and block diagram<br>Replaced pinout diagram with blank BGA352 template<br>Added LAN, LPC, and EEPROM pin descriptions, removed signals as req'd<br>Updated Functions 5 and 6 per engineering input | DH       |
| Revision 0.5     | 9/27/99  | Added Preliminary Ballout & Mechanical Spec                                                                                                                                                                                                                                                                             | DH       |
| Revision 0.6     | 10/1/99  | Updated pin descriptions and pin lists                                                                                                                                                                                                                                                                                  | DH       |
| Revision 0.7     | 10/15/99 | Updated pinouts to conform to engineering pinout revision 0.4 dated 10/6/99                                                                                                                                                                                                                                             | DH       |
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# **VT8231**

## **SOUTH BRIDGE**

### **PC99 COMPLIANT**

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INTEGRATED FAST ETHERNET, LPC, ISA / LPC BIOS ROM,  
INTEGRATED SOUNDBLASTER PRO / MULTICHANNEL  
DIRECT SOUND AC97 AUDIO AND MC97 MODEM INTERFACE,  
ULTRADMA-33/66/100 MASTER MODE EIDE CONTROLLER,  
4 PORT USB CONTROLLER, KEYBOARD CONTROLLER, RTC,  
SERIAL IRQ, SMBUS, SERIAL EEPROM,  
PLUG AND PLAY, ACPI, ENHANCED POWER MANAGEMENT,  
TEMPERATURE, VOLTAGE, AND FAN-SPEED MONITORING**

- **Inter-operable with VIA and other Host-to-PCI Bridges**

- Combine with VT82C598 for a complete Super-7 (66 / 75 / 83 / 100MHz) AGP 2x system (Apollo MVP3)
- Combine with VT8501 for a complete Super-7 system with integrated 2D / 3D graphics (Apollo MVP4)
- Combine with VT82C694X for a complete 66 / 100 / 133 MHz Socket370 / Slot1 AGP 4x system (Apollo Pro133A)
- Combine with VT8601 for a complete 66 / 100 / 133 MHz Socket370 / Slot1 system with integrated 2D / 3D graphics (Apollo ProMedia)
- Inter-operable with Intel or other Host-to-PCI bridges for a complete PC99 compliant PCI / AGP / LPC system

- **Integrated Peripheral Controllers**

- Integrated Fast Ethernet Controller with 1 / 10 / 100 Mbit capability
- Integrated USB Controller with two root hub and four function ports
- Dual channel UltraDMA-33 / 66 / 100 master mode EIDE controller
- AC-link interface for AC-97 audio codec and modem codec
- HSP modem support
- Interface for optional external modem DSP
- Integrated SoundBlasterPro / DirectSound compatible digital audio controller
- LPC interface for Low Pin Count interface to Super-I/O or ROM

- **Integrated Legacy Functions**

- Integrated Keyboard Controller with PS2 mouse support
- Integrated DS12885-style Real Time Clock with extended 256 byte CMOS RAM and Day/Month Alarm for ACPI
- Integrated Bus Controller including DMA, timer, and interrupt controller
- Serial IRQ for docking and non-docking applications
- Flash EPROM, 32Mbit (4Mbyte) EPROM and combined BIOS support
- Fast reset and Gate A20 operation

- **Fast Ethernet Controller**

- High performance PCI master interface with scatter / gather and bursting capability
- Standard MII interface to PHYceiver
- 1 / 10 / 100 MHz full and half duplex operation
- Transmit data buffer byte alignment for low CPU utilization
- Separate 2K byte FIFOs for receive and transmit of full Ethernet packets
- Flexible dynamically loadable EEPROM algorithm
- Physical, Broadcast, and Multicast address filtering using hashing function
- Flexible wakeup events: link status change, magic packet, unicast physical address match, predefined pattern match
- Software controllable power down

- **UltraDMA-33 / 66 / 100 Master Mode PCI EIDE Controller**

- Dual channel master mode PCI supporting four Enhanced IDE devices
- Transfer rate up to 100MB/sec to cover up to PIO mode 4, multi-word DMA mode 2, and UltraDMA mode 5
- Thirty-two levels (doublewords) of prefetch and write buffers per channel
- Dual DMA engine for concurrent dual channel operation
- Bus master programming interface for SFF-8038i rev.1.0 and Windows-95 / 98 / 2000 compliant
- Full scatter gather capability
- Support ATAPI compliant devices including DVD devices
- Support PCI native and ATA compatibility modes
- Complete software driver support

- **Integrated Super IO Controller**

- Supports 2 serial ports, IR port, parallel port, and floppy disk controller functions
- Two UARTs for Complete Serial Ports  
Programmable character lengths (5,6,7,8)  
Even, odd, stick or no parity bit generation and detection  
Programmable baud rate generator  
High speed baud rate (230Kbps, 460Kbps) support  
Independent transmit/receiver FIFOs  
Modem Control  
Plug and play with 96 base IO address and 12 IRQ options
- Fast IR (FIR) port  
IrDA 1.0 SIR and IrDA 1.1 FIR compliant  
IR function through the second serial port  
Infrared-IrDA (HPSIR) and ASK (Amplitude Shift Keyed) IR
- Multi-mode parallel port  
Standard mode, ECP and EPP support  
Dynamic and static switch between parallel port pinout and FDC pinout  
Plug and play with 192 base IO address, 12 IRQ and 4 DMA options
- Floppy Disk Controller  
16 bytes of FIFO  
Data rates up to 1Mbps  
Perpendicular recording driver support  
Two FDDs with drive swap support  
Plug and play with 48 base IO address, 12 IRQ and 4 DMA options



- **SoundBlaster Pro Hardware and Direct Sound Ready AC97 Digital Audio Controller**

- Up to six concurrent AC97 output channels for six-speaker surround sound experience
- Multiple Direct Sound channels between system memory and AC97 link
  - 10 Direct Sound output channels
  - 4 Direct Sound input channels
  - 8-channel hardware sample-rate-converter / mixer
  - 1 Surround Sound channel of up to six data streams
- PCI bus master interface with scatter / gather and bursting capability
- 32 byte FIFO for each direct sound channel
- Host based wave table synthesis
- Standard v1.03 or v2.1 AC97 Codec interface with up to four AC97 codec's from multiple vendors
- Loopback capability for re-directing mixed audio streams into USB and 1394 speakers
- Hardware SoundBlaster Pro for legacy compatibility
- Plug and play with 4 IRQ, 4 DMA, and 4 I/O space options for SoundBlaster Pro and MIDI hardware
- Hardware assisted FM synthesis for legacy compatibility
- Direct two game ports and one MIDI port interface
- Complete software driver support for Windows-95 / 98 / 2000 and Windows-NT

- **MC97 HSP Modem Controller**

- PCI bus master interface with scatter / gather and burst capability
- Standard AC97 codec interface for MC or AMC codec
- Wake on ring in APM or ACPI mode through AC97 link
- Supported by most HSP modem vendors

- **Universal Serial Bus Controller**

- USB v.1.1 and Intel Universal HCI v.1.1 compatible
- Eighteen level (doublewords) data FIFO with full scatter and gather capability
- Root hub and four function ports
- Integrated physical layer transceivers with optional over-current detection status on USB inputs
- Legacy keyboard and PS/2 mouse support

- **System Management Bus Interface**

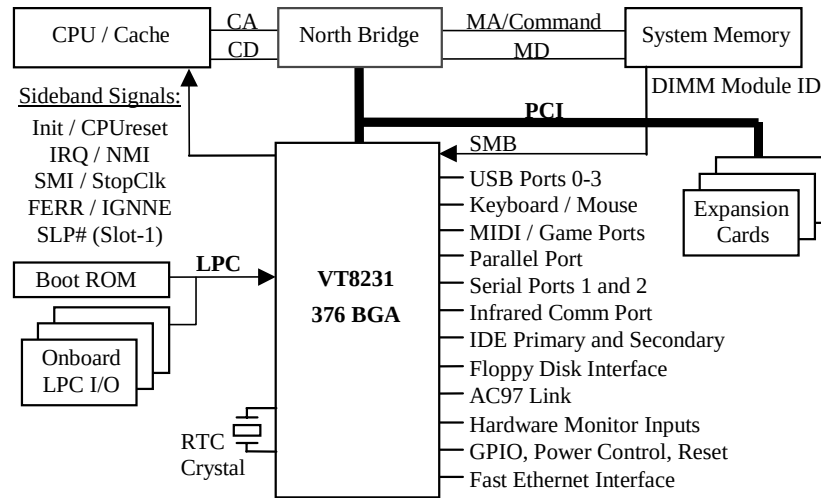
- One master / slave SMBus and one slave-only SMBus
- Host interface for processor communications
- Slave interface for external SMBus masters

- **Voltage, Temperature, Fan Speed Monitor and Controller**
  - Five universal input channels for voltage or temperature sensing
  - Two fan-speed monitoring channels
  - Input channel for thermal diode in Intel™ high speed Pentium II™ / Pentium III™ CPUs
  - Programmable control, status, monitor and alarm for flexible desktop management
  - External thermister or internal bandgap temperature sensing
  - Automatic clock throttling with integrated temperature sensing
  - Internal core VCC voltage sensing
  - Flexible external voltage sensing arrangement (any positive supply and battery)
- **Sophisticated PC99-Compatible Mobile Power Management**
  - Supports both ACPI (Advanced Configuration and Power Interface) and legacy (APM) power management
  - ACPI v1.0 Compliant
  - APM v1.2 Compliant
  - CPU clock throttling and clock stop control for complete ACPI C0 to C3 state support
  - PCI bus clock run, Power Management Enable (PME) control, and PCI/CPU clock generator stop control
  - Supports multiple system suspend types: power-on suspends with flexible CPU/PCI bus reset options, suspend to DRAM, and suspend to disk (soft-off), all with hardware automatic wake-up
  - Multiple suspend power plane controls and suspend status indicators
  - One idle timer, one peripheral timer and one general purpose timer, plus 24/32-bit ACPI compliant timer
  - Normal, doze, sleep, suspend and conserve modes
  - Global and local device power control
  - System event monitoring with two event classes
  - Primary and secondary interrupt differentiation for individual channels
  - Dedicated input pins for power and sleep buttons, external modem ring indicator, and notebook lid open/close for system wake-up
  - Multiple internal and external SMI sources for flexible power management models
  - One programmable chip select and one microcontroller chip select
  - Enhanced integrated real time clock (RTC) with date alarm, month alarm, and century field
  - Thermal alarm on either external or any combination of three internal temperature sensing circuits
  - Hot docking support
  - I/O pad leakage control
- **Plug and Play Controller**
  - PCI interrupts steerable to any interrupt channel
  - Steerable interrupts for integrated peripheral controllers: USB, floppy, serial, parallel, audio, soundblaster, MIDI
  - Steerable DMA channels for integrated floppy, parallel, and soundblaster pro controllers
  - One additional steerable interrupt channel for on-board plug and play devices
  - Microsoft Windows 2000™, Windows 98SE™, Windows 98™, Windows NT™, Windows 95™ and plug and play BIOS compliant
- **Built-in NAND-tree pin scan test capability**
- **0.30um, 3.3V, low power CMOS process**
- **Single chip 27x27 mm, 376 pin BGA**

## OVERVIEW

The VT8231 South Bridge is a high integration, high performance, power-efficient, and high compatibility device that supports Intel, AMD, and VIA / Cyrix based processor to PCI bus bridge functionality to make a complete Microsoft PC99-compliant PCI / LPC system. The VT8231 includes standard intelligent peripheral controllers:

- a) Master mode enhanced IDE controller with dual channel DMA engine and interlaced dual channel commands. Dedicated FIFO coupled with scatter and gather master mode operation allows high performance transfers between PCI and IDE devices. In addition to standard PIO and DMA mode operation, the VT8231 also supports the UltraDMA-33, 66, and 100 standards to allow reliable data transfer rates up to 100 MB/sec throughput. The IDE controller is SFF-8038i v1.0 and Microsoft Windows-family compliant.
- b) Integrated LAN Fast Ethernet controller (MAC) with Media Independent Interface (MII) to external PHY. The LAN controller operates at 1 / 10 / 100 Mbit/sec transfer rates using either full and half duplex operation and has separate 2Kbyte FIFOs for receive and transmit of full ethernet packets. The internal high-performance PCI interface has scatter / gather and bursting capability and can align bytes in the transmit data buffer to reduce CPU utilization. The LAN interface can perform address filtering on physical, broadcast, and multicast packets. The interface can also be configured for system wake up on link status change, receipt of magic packet, unicast physical address match on incoming packets, and predefined pattern match in the incoming data.
- c) LPC (Low Pin Count) interface for BIOS ROM plus optional conventional BIOS ROM support
- d) Universal Serial Bus controller that is USB v1.1 and Universal HCI v1.1 compliant. The VT8231 includes the root hub with four function ports with integrated physical layer transceivers. The USB controller allows hot plug and play and isochronous peripherals to be inserted into the system with universal driver support. The controller also implements legacy keyboard and mouse support so that legacy software can run transparently in a non-USB-aware operating system environment.
- e) Keyboard controller with PS2 mouse support
- f) Real Time Clock with 256 byte extended CMOS. In addition to standard RTC functionality, the integrated RTC also includes the date alarm, century field, and other enhancements for compatibility with the ACPI standard.
- g) Notebook-class power management functionality compliant with ACPI and legacy APM requirements. Multiple sleep states (power-on suspend, suspend-to-DRAM, and suspend-to-Disk) are supported with hardware automatic wake-up. Additional functionality includes event monitoring, CPU clock throttling and stop (Intel processor protocol), PCI bus clock stop control, modular power, clock and leakage control, hardware-based and software-based event handling, general purpose I/O, chip select and external SMI.
- h) Hardware monitoring subsystem for managing system / motherboard voltage levels, temperatures, and fan speeds
- i) Full System Management Bus (SMBus) interface with one master / slave port and one slave-only port
- j) 16550-compatible serial I/O port with "Fast-IR" infrared communications port option.
- k) Integrated PCI-mastering dual full-duplex direct-sound AC97-link-compatible sound system. Hardware soundblaster-pro and hardware-assisted FM blocks are included for Windows DOS box and real-mode DOS compatibility. Loopback capability is also implemented for directing mixed audio streams into USB and 1394 speakers for high quality digital audio.
- l) Game port and MIDI port
- m) Standard floppy disk drive interface
- n) ECP/EPP-capable parallel port with floppy disk controller pinout option
- o) Serial IRQ for docking and non-docking applications
- p) Plug and Play controller that allows complete steerability of all PCI interrupts and internal interrupts to any interrupt channel. One additional steerable interrupt channel is provided to allow plug and play and reconfigurability of on-board peripherals for Windows family compliance.



**Figure 1. PC System Configuration Using the VT8231**

# PINOUTS

## Pin Diagram

**Figure 2. VT8231 Ball Diagram (Top View)**

| Key | 1            | 2         | 3          | 4         | 5        | 6            | 7        | 8      | 9       | 10        | 11        | 12       | 13          | 14          | 15         | 16         | 17         | 18         | 19      | 20       |
|-----|--------------|-----------|------------|-----------|----------|--------------|----------|--------|---------|-----------|-----------|----------|-------------|-------------|------------|------------|------------|------------|---------|----------|
| A   | AD 30        | AD 31     | AD 26      | AD 24     | AD 21    | AD 16        | DEV SEL# | CBE 1# | AD 9    | AD 5      | STR#      | PD 2     | PD 6        | BUSY        | RTS#       | DTR#       | USB OC0#   | USB P2-    | USB P1- | USB P0-  |
| B   | PINT B#      | PINT A#   | AD 28      | AD 25     | AD 23    | AD 18        | T RDY#   | AD 15  | AD 10   | AD 4      | AD 1      | P INIT#  | PD 5        | ACK#        | TXD        | CTS#       | USB P3-    | USB P2+    | USB P1+ | USB P0+  |
| C   | PREQ H#      | PINT D#   | PINT C#    | AD 27     | CBE 3#   | AD 19        | I RDY#   | PAR    | AD 12   | AD 6      | AD 0      | PD 1     | PD 4        | PD 7        | USB CLK    | RI#        | USB P3+    | EE CS#     | EE DI   | EE DO    |
| D   | PGNT L#      | PREQ L#   | PGNT H#    | AD 29     | AD 20    | CBE 2#       | STOP #   | AD 14  | AD 7    | AD 2      | PD 0      | SLCT IN# | PE          | DSR#        | GND USB    | USB OC1#   | MD CK      | MD IO      | MRX D3  | MRX D2   |
| E   | RTC X2       | RTC X1    | PWR GD     | PCI RST#  | AD 22    | AD 17        | SERR #   | AD 13  | AD 8    | AD 3      | AUTO FD#  | PD 3     | SLCT        | RXD         | VCC USB    | EE CK      | MRX CLK    | MRX D1     | MRX D0  | MRX DV   |
| F   | JB B1        | V BAT     | INTR UDR#  | GPI 0     | RSM RST# | FRM#         | VCC      | AD 11  | VCC     | CBE 0#    | ERR#      | VCC      | VCC         | DCD#        | VCC        | VCC MII    | MTX CLK    | MRX ERR    | MTX ENA | MTX D0   |
| G   | AC SYNC      | AC RST    | JA B1      | MSI I2S   | JA X     | VCC          | GND      | VCC    | VCC     | VCC       | GND       | VCC      | GND RAM     | GND         | VCC RAM    | M CRS      | M COL      | MTX D1     | MTX D2  | MTX D3   |
| H   | AC SDIN0     | AC SDIN1  | AC SDO     | JB B2     | JA Y     | VCC          | H7       | 8      | 9       | 10        | 11        | 12       | 13          | H14         | GND        | TRK 00#    | WRT PRT#   | DSK CHG#   | HD SEL# | R DATA#  |
| J   | PCS1# SDIN2  | GPIOC     | AC BCLK    | MSO SPDIF | JB Y     | VCC          | J        | GND    | GND     | GND       | GND       | GND      | GND         | J           | VCC        | MTR 1#     | DS 0#      | STEP#      | W DATA# | W GATE#  |
| K   | VREF         | FAN 1     | FAN2 SLPB# | JA B2     | JB X     | GND          | K        | GND    | GND     | GND       | GND       | GND      | GND         | K           | VCC        | VCC MII    | DRV DEN1   | MTR 0#     | DS 1#   | DIR#     |
| L   | UIC 5        | DTD +     | DTD -      | UIC 4     | GND HWM  | VCC          | L        | GND    | GND     | GND       | GND       | GND      | GND         | L           | GND        | VCC PLL    | DRV DEN0   | PDCS 1#    | PDCS 3# | IN DEX#  |
| M   | UIC 1        | UIC 3     | UIC 2      | KB CK     | VCC HWM  | VCC          | M        | GND    | GND     | GND       | GND       | GND      | GND         | M           | VCC        | GND PLL    | PCI CLK    | PD A1      | PD A0   | PD A2    |
| N   | KB DT        | MS CK     | SUS C#     | MS DT     | SUS ST#  | VCC          | N7       | 8      | 9       | 10        | 11        | 12       | 13          | N14         | GND        | PD D10     | PD D5      | PD IOR#    | PD RDY  | PD DACK# |
| P   | SUSA #/strap | SUS B#    | AOL GPI    | SUS CLK   | VCC SUS  | VCC SUS      | GND      | VCC    | VCC     | GND       | VCC       | VCC      | VCC         | GND         | VCC        | PD D4      | PD D11     | PD D8      | PD DRQ  | PD IOW#  |
| R   | SMB CK2      | SMB DT2   | SMB CK1    | GPO 0     | CPU MISS | INTR         | VCC      | IR TX  | VCC     | VCC       | SD 6      | SD 0     | VCC         | VCC         | VCC        | PD D1      | PD D14     | PD D7      | PD D9   | PD D6    |
| T   | SMB DT1      | SMB ALRT# | BAT LOW#   | EXT SMI#  | NMI      | IGN NE#      | IO W#    | IR RX2 | ROM CS# | SD11 HG2# | SD 7      | OSC      | SA17 /strap | IRQ 14      | SA8 SDD8   | PD D0      | PD D15     | PD D13     | PD D3   | PD D12   |
| U   | PME#         | PWR BTN#  | RING #     | CPU RST   | FERR #   | SLP#         | IO R#    | IR RX  | SPKR    | SD12 LR1# | SD 5      | SD 4     | SA 18       | IRQ 15      | SA7 SDD7   | SA6 SDD6   | SD DRQ     | SDCS 1#    | SDCS 3# | PD D2    |
| V   | PCK RUN#     | GPIOA     | GPI 1      | WSC# ARQ# | INIT     | STP CLK#     | L AD3    | L AD0  | SER IRQ | SD15 LG2# | SD10 HR2# | SD 1     | SA 19       | SA5 SDD5    | SA11 SDD11 | SA2 SDD2   | SA14 SDD14 | SD A1      | SD A0   | SD A2    |
| W   | PCI STP#     | CPU STP#  | GPIOE      | APIC D0   | A20 M#   | MCCS #/strap | L AD2    | L FRM# | MEM R#  | SD14 LR2# | SD9 HG1#  | SD 2     | LA 20       | SA9 SDD9    | SA4 SDD4   | SA12 SDD12 | SA1 SDD1   | SA15 SDD15 | SD IOR# | SD DACK# |
| Y   | GPIOD        | LID       | APIC CLK   | APIC D1   | SMI#     | PCS0# /strap | L AD1    | L DRQ# | MEM W#  | SD13 LG1# | SD8 HR1#  | SD 3     | LA 21       | SA16 /strap | SA10 SDD10 | SA3 SDD3   | SA13 SDD13 | SA0 SDD0   | SD IOW# | SD RDY   |
|     | 1            | 2         | 3          | 4         | 5        | 6            | 7        | 8      | 9       | 10        | 11        | 12       | 13          | 14          | 15         | 16         | 17         | 18         | 19      | 20       |

Note: Some of the pins above have alternate functions and alternate names. The table above contains only one name (usually the most often used function), but the pin lists and pin descriptions contain all names.

**Pin Lists**
**Figure 3. VT8231 Pin List (Numerical Order)**

| Pin | Pin Name         | Pin        | Pin Name         | Pin        | Pin Name            | Pin        | Pin Name           | Pin | Pin Name          |
|-----|------------------|------------|------------------|------------|---------------------|------------|--------------------|-----|-------------------|
| A01 | IO AD30          | D12        | IO SLCTIN#/STEP# | H03        | O ACSOUT            | P02        | O SUSB# / GPIO2    | U13 | IO SA18           |
| A02 | IO AD31          | D13        | I PE / WDATA#    | H04        | I JBB2 / GAMED7     | P03        | I AOLGPI/THRM/I17  | U14 | I IRO15           |
| A03 | IO AD26          | D14        | I DSR#           | H05        | I JAY / GAMED1      | P04        | O SUSCLK / GPO4    | U15 | IO SA07 / SDD07   |
| A04 | IO AD24          | <b>D15</b> | <b>P GNDUSB</b>  | <b>H06</b> | <b>P VCC</b>        | <b>P05</b> | <b>P VCCSUS</b>    | U16 | IO SA06 / SDD06   |
| A05 | IO AD21          | D16        | I USB0C1#        | <b>H15</b> | <b>P GND</b>        | <b>P06</b> | <b>P VCCSUS</b>    | U17 | I SDDRO           |
| A06 | IO AD16          | D17        | O MDCK           | H16        | I TRK00#            | <b>P07</b> | <b>P GND</b>       | U18 | O SDCS1#          |
| A07 | IO DEVSEL#       | D18        | IO MDIO          | H17        | I WRTPT#            | <b>P08</b> | <b>P VCC</b>       | U19 | O SDCS3#          |
| A08 | IO CBE1#         | D19        | I MRXD3          | H18        | I DSKCHG#           | <b>P09</b> | <b>P VCC</b>       | U20 | IO PDD02          |
| A09 | IO AD09          | <b>D20</b> | <b>I MRXD2</b>   | H19        | OD HDSEL#           | <b>P10</b> | <b>P GND</b>       | V01 | IO PCKRUN#        |
| A10 | IO AD05          | E01        | O RTCX2          | H20        | I RDATA#            | <b>P11</b> | <b>P VCC</b>       | V02 | IO GPIOA / GPIO24 |
| A11 | IO STROBE#       | E02        | I RTCX1          | J01        | O PCS1# / SDI2 / IO | <b>P12</b> | <b>P VCC</b>       | V03 | I GPI1 / IRO8#    |
| A12 | IO PD2 / WRTPT#  | E03        | I PWRGD          | J02        | IO GPIOC/IO25/ATST  | <b>P13</b> | <b>P VCC</b>       | V04 | I WSC#/ARQ#124    |
| A13 | IO PD6           | E04        | O PCIRST#        | J03        | I ACBITCLK          | <b>P14</b> | <b>P GND</b>       | V05 | OD INIT           |
| A14 | I BUSY / MTR1#   | E05        | IO AD22          | J04        | O MSO / SPDIF       | <b>P15</b> | <b>P VCC</b>       | V06 | OD STPCLK#        |
| A15 | O RTS#           | E06        | IO AD17          | J05        | I JBY / GAMED3      | P16        | IO PDD04           | V07 | IO LAD3           |
| A16 | O DTR#           | E07        | I SERR#          | <b>J06</b> | <b>P VCC</b>        | P17        | IO PDD11           | V08 | IO LAD0           |
| A17 | I USB0C0#        | E08        | IO AD13          | <b>J15</b> | <b>P VCC</b>        | P18        | IO PDD08           | V09 | I SERIRQ#         |
| A18 | IO USBP2-        | E09        | IO AD08          | J16        | OD MTR1#            | P19        | I PDDRQ            | V10 | O LGT2#/SD15/O11  |
| A19 | IO USBP1-        | E10        | IO AD03          | J17        | OD DSE#             | P20        | O PDIOW#           | V11 | I HRQ2#/SD10/I11  |
| A20 | IO USBP0-        | E11        | IO AUTOFD#/DRV0  | J18        | OD STP#             | R01        | IO SMBCK2 / GPIO27 | V12 | IO SD01           |
| B01 | I PINTB#         | E12        | IO PD3 / RDATA#  | J19        | OD WDATA#           | R02        | IO SMBDT2 / GPIO26 | V13 | IO SA19           |
| B02 | I PINTA#         | E13        | I SLCT/WGATE#    | J20        | OD WGATE#           | R03        | IO SMBCK1          | V14 | IO SA05 / SDD05   |
| B03 | IO AD28          | E14        | I RXD            | <b>K01</b> | <b>P VREF</b>       | R04        | O SLOWCLK / O0     | V15 | IO SA11 / SDD11   |
| B04 | IO AD25          | <b>E15</b> | <b>P VCCUSB</b>  | K02        | I FAN1              | R05        | I CPUMISS / GPI16  | V16 | IO SA02 / SDD02   |
| B05 | IO AD23          | E16        | O EECK           | K03        | I FAN2/SLPB#/IO18   | R06        | OD INTR            | V17 | IO SA14 / SDD14   |
| B06 | IO AD18          | E17        | I MRXCLK / AIRO  | K04        | I JAB2 / GAMED5     | <b>R07</b> | <b>P VCC</b>       | V18 | O SDA1            |
| B07 | IO TRDY#         | E18        | I MRXD1          | K05        | I JBX / GAMED2      | R08        | O IRTX / GPO14     | V19 | O SDA0            |
| B08 | IO AD15          | E19        | I MRXD0 / AIRO   | <b>K06</b> | <b>P GND</b>        | <b>R09</b> | <b>P VCC</b>       | V20 | O SDA2            |
| B09 | IO AD10          | E20        | I MRXDV / AIRO   | <b>K15</b> | <b>P VCC</b>        | <b>R10</b> | <b>P VCC</b>       | W01 | O PCISTP# / GPO6  |
| B10 | IO AD04          | F01        | I JBB1 / GAMED6  | <b>K16</b> | <b>P VCCMII</b>     | R11        | IO SD06            | W02 | O CPUSTP# / GPO5  |
| B11 | IO AD01          | <b>F02</b> | <b>P VBAT</b>    | K17        | OD DRV DEN1         | R12        | IO SD00            | W03 | IO GPIOE / GPIO31 |
| B12 | IO PINT# / DIR#  | F03        | I INTRUDER#/GPI8 | K18        | OD MTR0#            | <b>R13</b> | <b>P VCC</b>       | W04 | O APD0/ACS#/IO28  |
| B13 | IO PD5           | F04        | I GPI0           | K19        | OD DS1#             | <b>R14</b> | <b>P VCC</b>       | W05 | OD A20M#          |
| B14 | I ACK# / DS1#    | F05        | I RSMRST#        | K20        | OD DIR#             | <b>R15</b> | <b>P VCC</b>       | W06 | O MCCS#/O17/strap |
| B15 | O TXD            | F06        | IO FRAME#        | L01        | AI UIC5             | R16        | IO PDD01           | W07 | IO LAD2           |
| B16 | I CTS#           | <b>F07</b> | <b>P VCC</b>     | L02        | AI DTD+             | R17        | IO PDD14           | W08 | O LFRAME#         |
| B17 | IO USBP3-        | F08        | IO AD11          | L03        | AI DTD-             | R18        | IO PDD07           | W09 | IO MEMR#          |
| B18 | IO USBP2+        | <b>F09</b> | <b>P VCC</b>     | L04        | AI UIC4             | R19        | IO PDD09           | W10 | I LRQ2#/SD14/I13  |
| B19 | IO USBP1+        | F10        | IO CBE0#         | <b>L05</b> | <b>P GNDHWM</b>     | R20        | IO PDD06           | W11 | O HGT1#/SD09/O8   |
| B20 | IO USBP0+        | F11        | I ERROR#/HDSEL#  | <b>L06</b> | <b>P VCC</b>        | T01        | IO SMBDT1          | W12 | IO SD02           |
| C01 | O PREOH#         | <b>F12</b> | <b>P VCC</b>     | <b>L15</b> | <b>P GND</b>        | T02        | I SMBALRT# / GPI7  | W13 | IO LA20/OC2#/O20  |
| C02 | I PINTD#         | <b>F13</b> | <b>P VCC</b>     | <b>L16</b> | <b>P VCCPLL</b>     | T03        | I BATLOW# / GPI5   | W14 | IO SA09 / SDD09   |
| C03 | I PINTC#         | F14        | I DCD#           | L17        | OD DRV DEN0         | T04        | IOD EXTSMI# / GPI2 | W15 | IO SA04 / SDD04   |
| C04 | IO AD27          | <b>F15</b> | <b>P VCC</b>     | L18        | O PDCS1#            | T05        | OD NMI             | W16 | IO SA12 / SDD12   |
| C05 | IO CBE3#         | F16        | I MTXCLK / AIRO  | L19        | O PDCS3#            | T06        | OD IGNNE#          | W17 | IO SA01 / SDD01   |
| C06 | IO AD19          | <b>F16</b> | <b>P VCCMII</b>  | L20        | I INDEX#            | T07        | IO IOW# / GPO23    | W18 | IO SA15 / SDD15   |
| C07 | IO IRDY#         | F18        | I MRXERR / AIRO  | M01        | AI UIC1             | T08        | I IRRX2 / GPI      | W19 | O SDIOR#          |
| C08 | IO PAR           | F19        | O MTXENA / AIRO  | M02        | AI UIC3             | T09        | O ROMCS#/KBCS#     | W20 | O SDDACK#         |
| C09 | IO AD12          | E20        | O MTXD0 / AIRO   | M03        | AI UIC2             | T10        | O HGNT2#/SD11/O9   | Y01 | IO IOD/30/SCO#/DT |
| C10 | IO AD06          | G01        | O ACSYNC         | M04        | IO KBCK / A20G      | T11        | IO SD07            | Y02 | I LID / GPI4      |
| C11 | IO AD00          | G02        | O ACRST          | <b>M05</b> | <b>P VCCHWM</b>     | T12        | I OSC              | Y03 | I APICCLK / GPI9  |
| C12 | IO PD1 / TRK00#  | G03        | I JAB1 / GAMED4  | <b>M06</b> | <b>P VCC</b>        | T13        | IO SA17 / strap    | Y04 | O APD1/AK#/IO29   |
| C13 | IO PD4 / DSKCHG# | G04        | I MSI / I2S      | <b>M15</b> | <b>P VCC</b>        | T14        | I IRQ14            | Y05 | OD SMI#           |
| C14 | IO PD7           | G05        | I JAX / GAMED0   | <b>M16</b> | <b>P GNDPLL</b>     | T15        | IO SA08 / SDD08    | Y06 | O PCS0#/O16/strap |
| C15 | I USBCLK         | <b>G06</b> | <b>P VCC</b>     | M17        | I PCICLK            | T16        | IO PDD00           | Y07 | IO LAD1           |
| C16 | I RI#            | <b>G07</b> | <b>P GND</b>     | M18        | O PDA1              | T17        | IO PDD15           | Y08 | I LDRQ#/SIN3/I15  |
| C17 | IO USBP3+        | <b>G08</b> | <b>P VCC</b>     | M19        | O PDA0              | T18        | IO PDD13           | Y09 | IO MEMW#          |
| C18 | O EECS#          | <b>G09</b> | <b>P VCC</b>     | M20        | O PDA2              | T19        | IO PDD03           | Y10 | O LG1# / SD13/O10 |
| C19 | I EEDI           | <b>G10</b> | <b>P VCC</b>     | N01        | IO KBDT / KBRC      | T20        | IO PDD12           | Y11 | I HRO1#/SD08/I10  |
| C20 | O EEDO           | <b>G11</b> | <b>P GND</b>     | N02        | IO MSCK / IRO1      | U01        | I PME# / GPI6      | Y12 | IO SD03           |
| D01 | I PGNTL#         | <b>G12</b> | <b>P VCC</b>     | N03        | O SUSC# / GPO       | U02        | I PWRBTN#          | Y13 | IO LA21/OC3#/O21  |
| D02 | O PREQL#         | <b>G13</b> | <b>P GNDDRAM</b> | N04        | IO MSDT / IRQ12     | U03        | I RING# / GPI3     | Y14 | IO SA16 / strap   |
| D03 | I PGNTH#         | <b>G14</b> | <b>P GND</b>     | N05        | O SUSST1# / GPO3    | U04        | OD CPURST          | Y15 | IO SA10 / SDD10   |
| D04 | IO AD29          | <b>G15</b> | <b>P VCCRAM</b>  | <b>N06</b> | <b>P VCC</b>        | U05        | I FERR#            | Y16 | IO SA03 / SDD03   |
| D05 | IO AD20          | G16        | I MCRS / AIRO    | <b>N15</b> | <b>P GND</b>        | U06        | OD SLP# / GPO7     | Y17 | IO SA13 / SDD13   |
| D06 | IO CBE2#         | G17        | I MCOL / AIRO    | N16        | IO PDD10            | U07        | IO IOR# / GPO22    | Y18 | IO SA00 / SDD00   |
| D07 | IO STOP#         | G18        | O MTXD1 / AIRO   | N17        | IO PDD05            | U08        | I IRRX / GPO15     | Y19 | O SDIOW#          |
| D08 | IO AD14          | G19        | O MTXD2 / AIRO   | N18        | O PDIOR#            | U09        | O SPKR             | Y20 | I SDRDY           |
| D09 | IO AD07          | G20        | O MTXD3 / AIRO   | N19        | I PDRDY             | U10        | I LREO1#/SD12/I12  |     |                   |
| D10 | IO AD02          | H01        | I ACSDIN0        | N20        | O PDDACK#           | U11        | IO SD05            |     |                   |
| D11 | IO PD0 / INDEX#  | H02        | I ACSDIN1        | P01        | O SUSAG/GPO1/strap  | U12        | IO SD04            |     |                   |

Center **GND** pins (24 pins): J8-J13, K8-K13, L8-L13, M8-M13



**Figure 4. VT8231 Pin List (Alphabetical Order)**

| Pin | Pin Name           | Pin | Pin Name           | Pin | Pin Name          | Pin | Pin Name         | Pin | Pin Name         |
|-----|--------------------|-----|--------------------|-----|-------------------|-----|------------------|-----|------------------|
| W05 | OD A20M#           | F11 | I ERROR#/HDSSEL#   | D18 | IO MDIO           | C03 | I PINTC#         | P01 | O SUSA# / GPO1   |
| J03 | I ACBITCLK         | T04 | IOD EXTSMI# / GPI2 | W09 | IO MEMR#          | C02 | I PINTD#         | P02 | O SUBS# / GPO2   |
| B14 | I ACK# / DS1#      | K02 | I FAN1             | Y09 | IO MEMW#          | U01 | I PME# / GPI6    | N03 | O SUSC#          |
| G02 | O ACRST            | K03 | I FAN2/SLPB#/IO18  | E17 | I MRXCLK / AIRO   | C01 | O PREOH#         | P04 | O SUSCLK         |
| H01 | I ACS DIN0         | U05 | I FERR#            | E19 | I MRXD0 / AIRO    | D02 | O PREOL#         | N05 | O SUSST1# / GPO3 |
| H02 | I ACS DIN1         | F06 | IO FRAME#          | E18 | I MRXD1           | U02 | I PWRBTN#        | B07 | IO TRDY#         |
| H03 | O ACS DOUT         | G07 | P GND              | D20 | I MRXD2           | E03 | I PWRGD          | H16 | I TRK00#         |
| G01 | O ACSYNC           | G11 | P GND              | D19 | I MRXD3           | H20 | I RDATA#         | B15 | O TXD            |
| C11 | IO AD00            | G14 | P GND              | E20 | I MRXDV / AIRO    | C16 | I RI#            | M01 | I UIC1           |
| B11 | IO AD01            | H15 | P GND              | F18 | I MRXERR/AIROQ    | U03 | I RING# / GPI3   | M03 | I UIC2           |
| D10 | IO AD02            | K06 | P GND              | N02 | IO MSCK / IRO1    | T09 | O ROMCS#/KBSC#   | M02 | I UIC3           |
| E10 | IO AD03            | L15 | P GND              | N04 | IO MSDT / IRO12   | F05 | I RSMRST#        | L04 | I UIC4           |
| B10 | IO AD04            | N15 | P GND              | G04 | I MSI / I2S       | E02 | I RTCX1          | L01 | I UIC5           |
| A10 | IO AD05            | P07 | P GND              | J04 | O MSO / SPDIF     | E01 | O RTCX2          | C15 | I USBCLK         |
| C10 | IO AD06            | P10 | P GND              | K18 | OD MTR0#          | A15 | O RTS#           | A17 | I USBOC0#        |
| D09 | IO AD07            | P14 | P GND              | J16 | OD MTR1#          | E14 | I RXD            | D16 | I USBOC1#        |
| E09 | IO AD08            | L05 | P GNDHWM           | F16 | I MTXCLK/AIRO     | Y18 | IO SA00 / SDD00  | A20 | IO USBP0-        |
| A09 | IO AD09            | M16 | P GNDPLL           | F20 | O MTXD0/AIRO      | W17 | IO SA01 / SDD01  | B20 | IO USBP0+        |
| B09 | IO AD10            | G13 | P GNDRAM           | G18 | O MTXD1/AIRO      | V16 | IO SA02 / SDD02  | A19 | IO USBP1-        |
| F08 | IO AD11            | D15 | P GNDUSB           | G19 | O MTXD2/AIROQ     | Y16 | IO SA03 / SDD03  | B19 | IO USBP1+        |
| C09 | IO AD12            | F04 | I GPI0             | G20 | O MTXD3/AIRO      | W15 | IO SA04 / SDD04  | A18 | IO USBP2-        |
| E08 | IO AD13            | V03 | I GPI1 / IRO8#     | F19 | O MTXENA/AIRO     | V14 | IO SA05 / SDD05  | B18 | IO USBP2+        |
| D08 | IO AD14            | V02 | IO GPIOA/24        | T05 | OD NMI            | U16 | IO SA06 / SDD06  | B17 | IO USBP3-        |
| B08 | IO AD15            | J02 | IO GPIOC/25/ATST   | T12 | I OSC             | U15 | IO SA07 / SDD07  | C17 | IO USBP3+        |
| A06 | IO AD16            | Y01 | IO GPIOD/30/SCI0U# | C08 | IO PAR            | T15 | IO SA08 / SDD08  | F02 | P VBAT           |
| E06 | IO AD17            | W03 | IO GPIOE           | V01 | IO PCKRUN#        | W14 | IO SA09 / SDD09  | F07 | P VCC            |
| B06 | IO AD18            | H19 | OD HDSSEL#         | M17 | I PCICLK          | Y15 | IO SA10 / SDD10  | F09 | P VCC            |
| C06 | IO AD19            | W11 | O HGNT1#/SD09/O8   | E04 | O PCIRST#         | V15 | IO SA11 / SDD11  | F12 | P VCC            |
| D05 | IO AD20            | T10 | O HGNT2#/SD11/O9   | W01 | O PCISTP# / GPO6  | W16 | IO SA12 / SDD12  | F13 | P VCC            |
| A05 | IO AD21            | Y11 | I HREQ1#/SD08/I10  | Y06 | O PCS0#/O16/strap | Y17 | IO SA13 / SDD13  | F15 | P VCC            |
| E05 | IO AD22            | V11 | I HREQ2#/SD10/I11  | J01 | O PCS1#/SIN2/IO19 | V17 | IO SA14 / SDD14  | G06 | P VCC            |
| B05 | IO AD23            | T06 | OD IGNNE#          | D11 | IO PD0/INDEX#     | W18 | IO SA15 / SDD15  | G08 | P VCC            |
| A04 | IO AD24            | L20 | I INDEX#           | C12 | IO PD1/TRK00#     | Y14 | IO SA16 / strap  | G09 | P VCC            |
| B04 | IO AD25            | V05 | OD INIT            | A12 | IO PD2/WRTPT#     | T13 | IO SA17 / strap  | G10 | P VCC            |
| A03 | IO AD26            | R06 | OD INTR            | E12 | IO PD3/RDATA#     | U13 | IO SA18          | G12 | P VCC            |
| C04 | IO AD27            | F03 | I INTRUDER#/GPI8   | C13 | IO PD4/DSKCHG#    | V13 | IO SA19          | H06 | P VCC            |
| B03 | IO AD28            | U07 | IO IOR# / GPO22    | B13 | IO PD5            | R12 | IO SD00          | J06 | P VCC            |
| D04 | IO AD29            | T07 | IO IOW# / GPO23    | A13 | IO PD6            | V12 | IO SD01          | J15 | P VCC            |
| A01 | IO AD30            | C07 | IO IRDY#           | C14 | IO PD7            | W12 | IO SD02          | K15 | P VCC            |
| A02 | IO AD31            | T14 | I IRO14            | M19 | O PDA0            | Y12 | IO SD03          | L06 | P VCC            |
| P03 | I AOLGPI/THRM/I17  | U14 | I IRO15            | M18 | O PDA1            | U12 | IO SD04          | M06 | P VCC            |
| Y03 | O APICLK / GPI9    | U08 | I IRRX / GPO15     | M20 | O PDA2            | U11 | IO SD05          | M15 | P VCC            |
| Y04 | I APICD1/AK#/IO29  | T08 | I IRRX2 / GPI      | L18 | O PDCS1#          | R11 | IO SD06          | N06 | P VCC            |
| W04 | O APICD0/ACS#/IO28 | R08 | O IRTX / GPO14     | L19 | O PDCS3#          | T11 | IO SD07          | P08 | P VCC            |
| E11 | IO AUTOFD# / DRV0  | G03 | I JAB1 / GAMED4    | T16 | IO PDD00          | V19 | O SDA0           | P09 | P VCC            |
| T03 | I BATLW# / GPI5    | K04 | I JAB2 / GAMED5    | R16 | IO PDD01          | V18 | O SDA1           | P11 | P VCC            |
| A14 | I BUSY / MTR1#     | G05 | I JAX / GAMED0     | U20 | IO PDD02          | V20 | O SDA2           | P12 | P VCC            |
| F10 | IO CBE0#           | H05 | I JAY / GAMED1     | T19 | IO PDD03          | U18 | O SDCS1#         | P13 | P VCC            |
| A08 | IO CBE1#           | F01 | I JBB1 / GAMED6    | P16 | IO PDD04          | U19 | O SDCS3#         | P15 | P VCC            |
| D06 | IO CBE2#           | H04 | I JBB2 / GAMED7    | N17 | IO PDD05          | W20 | O SDDACK#        | R07 | P VCC            |
| C05 | IO CBE3#           | K05 | I JBX / GAMED2     | R20 | IO PDD06          | U17 | I SDDRO          | R09 | P VCC            |
| R05 | I CPUMISS / GPI16  | J05 | I JBY / GAMED3     | R18 | IO PDD07          | W19 | O SDIOR#         | R10 | P VCC            |
| U04 | OD CPURST          | M04 | IO KBCK / A20G     | P18 | IO PDD08          | Y19 | O SDIOW#         | R13 | P VCC            |
| W02 | O CPURSTP# / GPO5  | N01 | IO KBDT / KBRC     | R19 | IO PDD09          | Y20 | I SDRDY          | R14 | P VCC            |
| B16 | I CTS#             | W13 | IO LA20/OC2#/O20   | N16 | IO PDD10          | V09 | I SERIRO#        | R15 | P VCC            |
| F14 | I DCD#             | Y13 | IO LA21/OC3#/O21   | P17 | IO PDD11          | E07 | I SERR#          | M05 | P VCCHWM         |
| A07 | IO DEVSEL#         | V08 | IO LAD0            | T20 | IO PDD12          | E13 | I SLCT/WGATE#    | F16 | P VCCMII         |
| K20 | OD DIR#            | Y07 | IO LAD1            | T18 | IO PDD13          | D12 | IO SLCTIN#/STEP# | K16 | P VCCMII         |
| L17 | OD DRV DEN0        | W07 | IO LAD2            | R17 | IO PDD14          | R04 | O SLOWCLK / O0   | L16 | P VCCPLL         |
| K17 | OD DRV DEN1        | V07 | IO LAD3            | T17 | IO PDD15          | U06 | OD SLP# / GPO7   | G15 | P VCCRAM         |
| J17 | OD DS0#            | Y08 | I LDRO#/SDIN3/I15  | N20 | O PDDACK#         | T02 | I SMBALRT# / I7  | P05 | P VCCSUS         |
| K19 | OD DS1#            | W08 | O LFRAME#          | P19 | I PDDRO           | R03 | IO SMBCK1        | P06 | P VCCSUS         |
| H18 | I DSKCHG#          | Y10 | O LGNT1#/SD13/O10  | N18 | O PDIOR#          | R01 | IO SMBCK2 / IO27 | E15 | P VCCUSB         |
| D14 | I DSR#             | V10 | O LGNT2#/SD15/O11  | P20 | O PDIOV#          | T01 | IO SMBDT1        | K01 | P VREF           |
| L02 | AI DTD+            | Y02 | I LID / GPI4       | N19 | I PDRDY           | R02 | IO SMBDT2 / IO26 | J19 | OD WDATA#        |
| L03 | AI DTD-            | U10 | I LREQ1#/SD12/I12  | D13 | I PE / WDATA#     | Y05 | OD SMI#          | J20 | OD WGATE#        |
| A16 | O DTR#             | W10 | I LREQ2#/SD14/I13  | D03 | I PGNT#           | U09 | O SPKR           | H17 | I WRTPT#         |
| E16 | O EECK             | W06 | O MCCS#/O17/strap  | D01 | I PGNTL#          | J18 | OD STEP#         | V04 | I WSC#/ARO#/I14  |
| C18 | O EECS#            | G17 | I MCOL / AIRO      | B12 | IO PINIT# / DIR#  | D07 | IO STOP#         |     |                  |
| C19 | I EEDI             | G16 | I MCRS / AIRO      | B02 | I PINTA#          | V06 | OD STPCLK#       |     |                  |
| C20 | O EEDO             | D17 | O MDCK             | B01 | I PINTB#          | A11 | IO STROBE#       |     |                  |

Center **GND** pins (24 pins): J8-J13, K8-K13, L8-L13, M8-M13

## Pin Descriptions

**Table 1. Pin Descriptions**

| PCI Bus Interface |                 |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
|-------------------|-----------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|---------------|------------|-------|-------|-------|-------|------------|-------|-------|-------|-------|------------|-------|-------|-------|-------|------------|-------|-------|-------|-------|------------|-------|-------|-------|-------|
| Signal Name       | Pin #           | I/O           | Signal Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| AD[31:0]          | (see pin list)  | IO            | <b>Address/Data Bus.</b> The standard PCI address and data lines. The address is driven with FRAME# assertion and data is driven or received in following cycles.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| C/BE[3:0]#        | C5, D6, A8, F10 | IO            | <b>Command/Byte Enable.</b> The command is driven with FRAME# assertion. Byte enables corresponding to supplied or requested data are driven on following clocks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| FRAME#            | F6              | IO            | <b>Frame.</b> Assertion indicates the address phase of a PCI transfer. Negation indicates that one more data transfer is desired by the cycle initiator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| IRDY#             | C7              | IO            | <b>Initiator Ready.</b> Asserted when the initiator is ready for data transfer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| TRDY#             | B7              | IO            | <b>Target Ready.</b> Asserted when the target is ready for data transfer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| STOP#             | D7              | IO            | <b>Stop.</b> Asserted by the target to request the master to stop the current transaction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| DEVSEL#           | A7              | IO            | <b>Device Select.</b> The VT8231 asserts this signal to claim PCI transactions through positive or subtractive decoding. As an input, DEVSEL# indicates the response to a VT8231-initiated transaction and is also sampled when decoding whether to subtractively decode the cycle.                                                                                                                                                                                                                                                                                                                                                                                        |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PAR               | C8              | IO            | <b>Parity.</b> A single parity bit is provided over AD[31:0] and C/BE[3:0]#.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| SERR#             | E7              | I             | <b>System Error.</b> SERR# can be pulsed active by any PCI device that detects a system error condition. Upon sampling SERR# active, the VT8231 can be programmed to generate an NMI to the CPU.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PINTA-D#          | B2, B1, C3, C2  | I             | <b>PCI Interrupt Request.</b> These pins are typically connected to the PCI bus INTA#-INTD# pins as follows: <table><tr><td></td><td><u>PINTA#</u></td><td><u>PINTB#</u></td><td><u>PINTC#</u></td><td><u>PINTD#</u></td></tr><tr><td>PCI Slot 1</td><td>INTA#</td><td>INTB#</td><td>INTC#</td><td>INTD#</td></tr><tr><td>PCI Slot 2</td><td>INTB#</td><td>INTC#</td><td>INTD#</td><td>INTA#</td></tr><tr><td>PCI Slot 3</td><td>INTC#</td><td>INTD#</td><td>INTA#</td><td>INTB#</td></tr><tr><td>PCI Slot 4</td><td>INTD#</td><td>INTA#</td><td>INTB#</td><td>INTC#</td></tr><tr><td>PCI Slot 5</td><td>INTA#</td><td>INTB#</td><td>INTC#</td><td>INTD#</td></tr></table> |               | <u>PINTA#</u> | <u>PINTB#</u> | <u>PINTC#</u> | <u>PINTD#</u> | PCI Slot 1 | INTA# | INTB# | INTC# | INTD# | PCI Slot 2 | INTB# | INTC# | INTD# | INTA# | PCI Slot 3 | INTC# | INTD# | INTA# | INTB# | PCI Slot 4 | INTD# | INTA# | INTB# | INTC# | PCI Slot 5 | INTA# | INTB# | INTC# | INTD# |
|                   | <u>PINTA#</u>   | <u>PINTB#</u> | <u>PINTC#</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <u>PINTD#</u> |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCI Slot 1        | INTA#           | INTB#         | INTC#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTD#         |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCI Slot 2        | INTB#           | INTC#         | INTD#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTA#         |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCI Slot 3        | INTC#           | INTD#         | INTA#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTB#         |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCI Slot 4        | INTD#           | INTA#         | INTB#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTC#         |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCI Slot 5        | INTA#           | INTB#         | INTC#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTD#         |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PREQH#            | C1              | O             | <b>PCI Request.</b> This signal goes to the North Bridge to request the PCI bus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PGNTH#            | D3              | I             | <b>PCI Grant.</b> This signal is driven by the North Bridge to grant PCI access to the VT8231.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PREQL#            | D2              | O             | <b>PCI Request.</b> This signal goes to the North Bridge to request the PCI bus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PGNTL#            | D1              | I             | <b>PCI Grant.</b> This signal is driven by the North Bridge to grant PCI access to the VT8231.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCICLK            | M17             | I             | <b>PCI Clock.</b> PCLK provides timing for all transactions on the PCI Bus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCKRUN#           | V1              | IO            | <b>PCI Bus Clock Run.</b> This signal indicates whether the PCI clock is or will be stopped (high) or running (low). The VT8231 drives this signal low when the PCI clock is running (default on reset) and releases it when it stops the PCI clock. External devices may assert this signal low to request that the PCI clock be restarted or prevent it from stopping. Connect this pin to ground using a 100 Ω resistor if the function is not used. Refer to the “PCI Mobile Design Guide” and the VIA “Apollo MVP4 Design Guide” for more details.                                                                                                                    |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCIRST#           | E4              | O             | <b>PCI Reset.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| PCISTP# / GPO6    | W1              | O             | <b>PCI Stop.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |
| CPUSTP# / GPO5    | W2              | O             | <b>CPU Stop.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |               |               |               |               |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |            |       |       |       |       |



| CPU Interface      |       |          |                                                                                                                                                                                                                    |
|--------------------|-------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name        | Pin # | I/O      | Signal Description                                                                                                                                                                                                 |
| <b>CPURST</b>      | U4    | OD       | <b>CPU Reset.</b> The VT8231 asserts CPURST to reset the CPU during power-up.                                                                                                                                      |
| <b>INTR</b>        | R6    | OD       | <b>CPU Interrupt.</b> INTR is driven by the VT8231 to signal the CPU that an interrupt request is pending and needs service.                                                                                       |
| <b>NMI</b>         | T5    | OD       | <b>Non-Maskable Interrupt.</b> NMI is used to force a non-maskable interrupt to the CPU. The VT8231 generates an NMI when either SERR# or IOCHK# is asserted.                                                      |
| <b>INIT</b>        | V5    | OD       | <b>Initialization.</b> The VT8231 asserts INIT if it detects a shut-down special cycle on the PCI bus or if a soft reset is initiated by the register                                                              |
| <b>STPCLK#</b>     | V6    | OD       | <b>Stop Clock.</b> STPCLK# is asserted by the VT8231 to the CPU to throttle the processor clock.                                                                                                                   |
| <b>SMI#</b>        | Y5    | OD       | <b>System Management Interrupt.</b> SMI# is asserted by the VT8231 to the CPU in response to different Power-Management events.                                                                                    |
| <b>FERR#</b>       | U5    | I        | <b>Numerical Coprocessor Error.</b> This signal is tied to the coprocessor error signal on the CPU. Internally generates interrupt 13 if active.                                                                   |
| <b>IGNNE#</b>      | T6    | OD       | <b>Ignore Numeric Error.</b> This pin is connected to the "ignore error" pin on the CPU.                                                                                                                           |
| <b>SLP# / GPO7</b> | U6    | OD       | <b>Sleep</b> (Rx75[7] = 0). Used to put the CPU to sleep. Used with slot-1 CPUs only. Not currently used with socket-7 CPUs.                                                                                       |
| <b>A20M#</b>       | W5    | OD       | <b>A20 Mask.</b> Connect to A20 mask input of the CPU to control address bit-20 generation. Logical combination of the A20GATE input (from internal or external keyboard controller) and Port 92 bit-1 (Fast_A20). |
| <b>DTD+</b>        | L2    | Analog I | <b>CPU DTD (Thermal Diode) Channel Plus.</b> Connect to cathode of first external temperature sensing diode.                                                                                                       |
| <b>DTD-</b>        | L3    | Analog I | <b>CPU DTD (Thermal Diode) Channel Minus.</b> Connect to anode of first external temperature sensing diode.                                                                                                        |

Note: Connect each of the above signals to 4.7K  $\Omega$  pullup resistors to VCC3.

| Strap Options                 |       |           |                                                                               |
|-------------------------------|-------|-----------|-------------------------------------------------------------------------------|
| Signal Name                   | Pin # | I/O       | Signal Description                                                            |
| <b>Strap / SUSA#</b>          | P1    | I / O     | <b>CPURST / INIT Polarity</b><br>H:<br>L:                                     |
| <b>Strap / MCCS#</b>          | W6    | I / O     | <b>CPU Frequency Strapping</b><br>H: Disable<br>L: Enable                     |
| <b>Strap / PCS0#</b>          | Y6    | I / O     | <b>SD Bus Width</b><br>H: 16-Bit<br>L: 8-Bit                                  |
| <b>Strap / SA16</b>           | Y14   | I / IO    | <b>BIO ROM Interface</b><br>H: LPC<br>L: Conventional                         |
| <b>Strap / SA17</b>           | T13   | I / IO    | <b>Auto Reboot</b><br>H: Disable<br>L: Enable                                 |
| <b>Strap / KBCS# / ROMCS#</b> | T9    | I / O / O | <b>CPU Type</b><br>4.7K to GND = Socket-7, 4.7K to VCC3 = Socket-370 / Slot-1 |

### Advanced Programmable Interrupt Controller (APIC) Interface

| Signal Name                         | Pin # | I/O              | Signal Description                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------|-------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WSC# / APICREQ# / GPI14             | V4    | I / I / I        | <b>Internal APIC Write Snoop Complete.</b> Asserted by the north bridge to indicate that all snoop activity on the CPU bus initiated by the last PCI-to-DRAM write is complete and that it is safe to perform an APIC interrupt.<br><b>External APIC Request.</b> Asserted by external APIC synchronous to PCICLK prior to sending an interrupt over the APIC serial bus. This signals the VT8231 to flush its internal buffers. |
| APICD0 / APICCS# / GPIO28           | W4    | O / O / IO       | <b>Internal APIC Data 0.</b><br><b>External APIC Chip Select.</b> The VT8231 drives this signal active to select an external APIC (if used). This occurs if the external APIC is enabled and a PCI cycle is detected within the programmed APIC address range.                                                                                                                                                                   |
| APICD1 / APICACK# / GPIO29          | Y4    | O / O / IO       | <b>Internal APIC Data 1.</b><br><b>External APIC Acknowledge.</b> Asserted by the VT8231 to indicate that its internal buffers have been flushed (in response to APICREQ#). This indicates to the external APIC that the VT8231's internal buffers have been flushed and that it is OK for the APIC to send its interrupt.                                                                                                       |
| APICCLK / GPI9                      | Y3    | I / I            | <b>APIC Clock.</b>                                                                                                                                                                                                                                                                                                                                                                                                               |
| SCIOUT# / GPIOD<br>/ GPIO30 / DTEST | Y1    | O / IO<br>IO / O | <b>SCI Out.</b> Used to route internally generated SCI and SMBus interrupts to external APIC (if used). Defined as SCIOUT# if external APIC enabled (function 0 Rx74[7] = 1).                                                                                                                                                                                                                                                    |
| AIRQ / MCOL                         | G17   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MCRS                         | G16   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MRXCLK                       | E17   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MRXD0                        | E19   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MRXDV                        | E20   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MRXERR                       | F18   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MTXCLK                       | F16   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MTXD0                        | F20   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MTXD1                        | G18   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MTXD2                        | G19   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MTXD3                        | G20   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |
| AIRQ / MTXENA                       | F19   | O                | <b>APIC IRQ.</b> Internal condition for connection to external APIC.                                                                                                                                                                                                                                                                                                                                                             |

### Serial EEPROM Interface

| Signal Name | Pin # | I/O | Signal Description                |
|-------------|-------|-----|-----------------------------------|
| EECS#       | C18   | O   | <b>Serial EEPROM Chip Select.</b> |
| EECK        | E16   | O   | <b>Serial EEPROM Clock.</b>       |
| EEDO        | C20   | O   | <b>Serial EEPROM Data Output.</b> |
| EEDI        | C19   | I   | <b>Serial EEPROM Data Input.</b>  |

| <b>Low Pin Count (LPC) Interface</b> |                |            |                                 |
|--------------------------------------|----------------|------------|---------------------------------|
| <b>Signal Name</b>                   | <b>Pin #</b>   | <b>I/O</b> | <b>Signal Description</b>       |
| <b>LFRAME#</b>                       | W8             | O          | <b>LPC Frame.</b>               |
| <b>LDRQ# / ACS DIN3 / GPI15</b>      | Y8             | I / I / I  | <b>LPC Data Request.</b>        |
| <b>LAD[3-0]</b>                      | V7, W7, Y7, V8 | IO / IO    | <b>LPC Address / Data.</b>      |
| <b>HREQ1# / SD8 / GPI10</b>          | Y11            | I / IO     | <b>High Priority Request 1.</b> |
| <b>HGNT1# / SD9 / GPO8</b>           | W11            | O / IO     | <b>High Priority Grant 1.</b>   |
| <b>HREQ2# / SD10 / GPI11</b>         | V11            | I / IO     | <b>High Priority Request 2.</b> |
| <b>HGNT2# / SD11 / GPO9</b>          | T10            | O / IO     | <b>High Priority Grant 2.</b>   |
| <b>LREQ1# / SD12 / GPI12</b>         | U10            | I / IO     | <b>Low Priority Request 1.</b>  |
| <b>LGNT1# / SD13 / GPO10</b>         | Y10            | O / IO     | <b>Low Priority Grant 1.</b>    |
| <b>LREQ2# / SD14 / GPI13</b>         | W10            | I / IO     | <b>Low Priority Request 2.</b>  |
| <b>LGNT2# / SD15 / GPO11</b>         | V10            | O / IO     | <b>Low Priority Grant 2.</b>    |

Note: Connect the LPC interface LPCRST# (LPC Reset) signal to PCIRST#

| <b>LAN Controller - Media Independent Interface (MII)</b> |              |            |                                                                                                          |
|-----------------------------------------------------------|--------------|------------|----------------------------------------------------------------------------------------------------------|
| <b>Signal Name</b>                                        | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>                                                                                |
| <b>MCOL / APICIRQ</b>                                     | G17          | I / I      | <b>MII Collision Detect.</b> From the external PHY.                                                      |
| <b>MCRS / APICIRQ</b>                                     | G16          | I / I      | <b>MII Carrier Sense.</b> Asserted by the external PHY when the media is active.                         |
| <b>MDCK</b>                                               | D17          | O          | <b>MII Management Data Clock.</b> Sent to the external PHY as a timing reference for MDIO                |
| <b>MDIO</b>                                               | D18          | IO         | <b>MII Management Data I/O.</b> Read from the MDI bit or written to the MDO bit.                         |
| <b>MRXCLK / APICIRQ</b>                                   | E17          | I / I      | <b>MII Receive Clock.</b> 2.5 or 25 MHz clock recovered by the PHY.                                      |
| <b>MRXD[3],</b>                                           | D19          | I          | <b>MII Receive Data.</b> Parallel receive data lines driven by the external PHY synchronous with MRXCLK. |
| <b>MRXD[2],</b>                                           | D20          | I          |                                                                                                          |
| <b>MRXD[1],</b>                                           | E18          | I          |                                                                                                          |
| <b>MRXD[0] / APICIRQ</b>                                  | E19          | I / I      |                                                                                                          |
| <b>MRXDV / APICIRQ</b>                                    | E20          | I / I      | <b>MII Receive Data Valid.</b>                                                                           |
| <b>MRXERR / APICIRQ</b>                                   | F18          | I / I      | <b>MII Receive Error.</b> Asserted by the PHY when it detects a data decoding error.                     |
| <b>MTXCLK / APICIRQ</b>                                   | F16          | I / I      | <b>MII Transmit Clock.</b> Always active 2.5 or 25 MHz clock supplied by the PHY.                        |
| <b>MTXD[3] / APICIRQ,</b>                                 | G20          | O / I      | <b>MII Transmit Data.</b> Parallel transmit data lines synchronized to MTXCLK.                           |
| <b>MTXD[2] / APICIRQ,</b>                                 | G19          | O / I      |                                                                                                          |
| <b>MTXD[1] / APICIRQ,</b>                                 | G18          | O / I      |                                                                                                          |
| <b>MTXD[0] / APICIRQ</b>                                  | F20          | O / I      |                                                                                                          |
| <b>MTXENA / APICIRQ</b>                                   | F19          | O / I      | <b>MII Transmit Enable.</b> Indicates transmit active from the MII port to the PHY.                      |

| Universal Serial Bus Interface |       |            |                                                                                 |
|--------------------------------|-------|------------|---------------------------------------------------------------------------------|
| Signal Name                    | Pin # | I/O        | Signal Description                                                              |
| <b>USBP0+</b>                  | B20   | IO         | <b>USB Port 0 Data +</b>                                                        |
| <b>USBP0-</b>                  | A20   | IO         | <b>USB Port 0 Data -</b>                                                        |
| <b>USBP1+</b>                  | B19   | IO         | <b>USB Port 1 Data +</b>                                                        |
| <b>USBP1-</b>                  | A19   | IO         | <b>USB Port 1 Data -</b>                                                        |
| <b>USBP2+</b>                  | B18   | IO         | <b>USB Port 2 Data +</b>                                                        |
| <b>USBP2-</b>                  | A18   | IO         | <b>USB Port 2 Data -</b>                                                        |
| <b>USBP3+</b>                  | C17   | IO         | <b>USB Port 3 Data +</b>                                                        |
| <b>USBP3-</b>                  | B17   | IO         | <b>USB Port 3 Data -</b>                                                        |
| <b>USBCLK</b>                  | C15   | I          | <b>USB Clock.</b> 48MHz clock input for the USB interface                       |
| <b>USBOC0#</b>                 | A17   | I          | <b>USB Port 0 Over Current Detect.</b> Port 0 is disabled if this input is low. |
| <b>USBOC1#</b>                 | D16   | I          | <b>USB Port 1 Over Current Detect.</b> Port 1 is disabled if this input is low  |
| <b>USBOC2# / LA20 / GPO20</b>  | W13   | I / IO / O | <b>USB Port 2 Over Current Detect.</b> Port 2 is disabled if this input is low. |
| <b>USBOC3# / LA21 / GPO21</b>  | Y13   | I / IO / O | <b>USB Port 3 Over Current Detect.</b> Port 3 is disabled if this input is low. |

| System Management Bus (SMB) Interface (I <sup>2</sup> C Bus) |       |         |                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------|-------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name                                                  | Pin # | I/O     | Signal Description                                                                                                                                                                                                                                                                                |
| <b>SMBCK1</b>                                                | R3    | IO      | <b>SMB / I<sup>2</sup>C Channel 1 Clock.</b>                                                                                                                                                                                                                                                      |
| <b>SMBCK2 / GPIO27</b>                                       | R1    | IO / IO | <b>SMB / I<sup>2</sup>C Channel 2 Clock.</b>                                                                                                                                                                                                                                                      |
| <b>SMBDT1</b>                                                | T1    | IO      | <b>SMB / I<sup>2</sup>C Channel 1 Data.</b>                                                                                                                                                                                                                                                       |
| <b>SMBDT2 / GPIO26</b>                                       | R2    | IO / IO | <b>SMB / I<sup>2</sup>C Channel 2 Data.</b>                                                                                                                                                                                                                                                       |
| <b>SMBALRT# / GPI7</b>                                       | T2    | I / I   | <b>SMB Alert.</b> (System Management Bus I/O space Rx08[3] = 1) When the chip is enabled to allow it, assertion generates an IRQ or SMI interrupt or a power management resume event. The same pin is used as General Purpose Input 6 whose value is reflected in Rx48[6] of function 4 I/O space |

| <b>UltraDMA-33 / 66 Enhanced IDE Interface</b> |              |            |                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------|--------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Signal Name</b>                             | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>                                                                                                                                                                                                                                                                                                                                                        |
| <b>PDRDY / PDDMARDY / PDSTROBE</b>             | N19          | I          | EIDE Mode: <b>Primary I/O Channel Ready.</b> Device ready indicator<br>UltraDMA Mode: <b>Primary Device DMA Ready.</b> Output flow control. The device may assert DDMARDY to pause output transfers<br><b>Primary Device Strobe.</b> Input data strobe (both edges). The device may stop DSTROBE to pause input data transfers                                                   |
| <b>SDRDY / SDDMARDY / SDSTROBE</b>             | Y20          | I          | EIDE Mode: <b>Secondary I/O Channel Ready.</b> Device ready indicator<br>UltraDMA Mode: <b>Secondary Device DMA Ready.</b> Output flow control. The device may assert DDMARDY to pause output transfers<br><b>Secondary Device Strobe.</b> Input data strobe (both edges). The device may stop DSTROBE to pause input data transfers                                             |
| <b>PDIOR# / PHDMARDY / PHSTROBE</b>            | N18          | O          | EIDE Mode: <b>Primary Device I/O Read.</b> Device read strobe<br>UltraDMA Mode: <b>Primary Host DMA Ready.</b> Primary channel input flow control. The host may assert HDMARDY to pause input transfers<br><b>Primary Host Strobe.</b> Output data strobe (both edges). The host may stop HSTROBE to pause output data transfers                                                 |
| <b>SDIOR# / SHDMARDY / SHSTROBE</b>            | W19          | O          | EIDE Mode: <b>Secondary Device I/O Read.</b> Device read strobe<br>UltraDMA Mode: <b>Secondary Host DMA Ready.</b> Input flow control. The host may assert HDMARDY to pause input transfers<br><b>Host Strobe B.</b> Output strobe (both edges). The host may stop HSTROBE to pause output data transfers                                                                        |
| <b>PDIOW# / PSTOP</b>                          | P20          | O          | EIDE Mode: <b>Primary Device I/O Write.</b> Device write strobe<br>UltraDMA Mode: <b>Primary Stop.</b> Stop transfer: Asserted by the host prior to initiation of an UltraDMA burst; negated by the host before data is transferred in an UltraDMA burst. Assertion of STOP by the host during or after data transfer in UltraDMA mode signals the termination of the burst.     |
| <b>SDIOW# / SSTOP</b>                          | Y19          | O          | EIDE Mode: <b>Secondary Device I/O Write.</b> Device write strobe<br>UltraDMA Mode: <b>Secondary Stop.</b> Stop transfer: Asserted by the host prior to initiation of an UltraDMA burst; negated by the host before data is transferred in an UltraDMA burst. Assertion of STOP by the host during or after data transfer in UltraDMA mode signals the termination of the burst. |
| <b>PDDRQ</b>                                   | P19          | I          | <b>Primary Device DMA Request.</b> Primary channel DMA request                                                                                                                                                                                                                                                                                                                   |
| <b>SDDRQ</b>                                   | U17          | I          | <b>Secondary Device DMA Request.</b> Secondary channel DMA request                                                                                                                                                                                                                                                                                                               |
| <b>PDDACK#</b>                                 | N20          | O          | <b>Primary Device DMA Acknowledge.</b> Primary channel DMA acknowledge                                                                                                                                                                                                                                                                                                           |
| <b>SDDACK#</b>                                 | W20          | O          | <b>Secondary Device DMA Acknowledge.</b> Secondary channel DMA acknowledge                                                                                                                                                                                                                                                                                                       |
| <b>IRQ14</b>                                   | T14          | I          | <b>Primary Channel Interrupt Request.</b>                                                                                                                                                                                                                                                                                                                                        |
| <b>IRQ15</b>                                   | U14          | I          | <b>Secondary Channel Interrupt Request.</b>                                                                                                                                                                                                                                                                                                                                      |

| UltraDMA-33 / 66 Enhanced IDE Interface (continued) |                                                                                |     |                                                                                                                                             |
|-----------------------------------------------------|--------------------------------------------------------------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name                                         | Pin #                                                                          | I/O | Signal Description                                                                                                                          |
| PDCS1#                                              | L18                                                                            | O   | <b>Primary Master Chip Select.</b> This signal corresponds to CS1FX# on the primary IDE connector.                                          |
| PDCS3#                                              | L19                                                                            | O   | <b>Primary Slave Chip Select.</b> This signal corresponds to CS3FX# on the primary IDE connector.                                           |
| SDCS1#                                              | U18                                                                            | O   | <b>Secondary Master Chip Select.</b> This signal corresponds to CS17X# on the secondary IDE connector.                                      |
| SDCS3#                                              | U19                                                                            | O   | <b>Secondary Slave Chip Select.</b> This signal corresponds to CS37X# on the secondary IDE connector.                                       |
| PDA[2-0]                                            | M20, M18, M19                                                                  | O   | <b>Primary Disk Address.</b> PDA[2:0] are used to indicate which byte in either the ATA command block or control block is being accessed.   |
| SDA[2-0]                                            | V20, V18, V19                                                                  | O   | <b>Secondary Disk Address.</b> SDA[2:0] are used to indicate which byte in either the ATA command block or control block is being accessed. |
| PDD[15-0]                                           | T17, R17, T18, T20, P17, N16, R19, P18, R18, R20, N17, P16, T19, U20, R16, T16 | IO  | <b>Primary Disk Data</b>                                                                                                                    |
| SDD[15-0] / SA[15-0]                                | W18, V17, Y17, W16, V15, Y15, W14, T15, U15, U16, V14, W15, Y16, V16, W17, Y18 | IO  | <b>Secondary Disk Data</b> (SPKR strap 4.7K ohms low) <u>or</u> <b>ISA Address</b> (SPKR strap 4.7K ohms high)                              |

| <b>MIDI Interface</b> |              |            |                           |
|-----------------------|--------------|------------|---------------------------|
| <b>Signal Name</b>    | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b> |
| <b>MSI / I2S</b>      | G4           | I / I      | <b>MIDI Serial In</b>     |
| <b>MSO / SPDIF</b>    | J4           | O / O      | <b>MIDI Serial Out</b>    |

| <b>Serial Digital Audio Interface</b> |              |            |                                  |
|---------------------------------------|--------------|------------|----------------------------------|
| <b>Signal Name</b>                    | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>        |
| <b>I2S / MSI</b>                      | G4           | I / I      | <b>Serial Digital Audio In.</b>  |
| <b>SPDIF / MSO</b>                    | J4           | O / O      | <b>Serial Digital Audio Out.</b> |

| <b>AC97 Audio / Modem Interface</b> |              |            |                              |
|-------------------------------------|--------------|------------|------------------------------|
| <b>Signal Name</b>                  | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>    |
| <b>ACRST</b>                        | G2           | O          | <b>AC97 Reset</b>            |
| <b>ACSYNC</b>                       | G1           | O          | <b>AC97 Sync</b>             |
| <b>ACSDOUT</b>                      | H3           | O          | <b>AC97 Serial Data Out</b>  |
| <b>ACSDIN0</b>                      | H1           | I          | <b>AC97 Serial Data In 0</b> |
| <b>ACSDIN1</b>                      | H2           | I          | <b>AC97 Serial Data In 1</b> |
| <b>ACSDIN2 / PCS1# / GPIO19</b>     | J1           | I / O / IO | <b>AC97 Serial Data In 2</b> |
| <b>ACSDIN3 / LDRQ# / GPI5</b>       | Y8           | I / I / I  | <b>AC97 Serial Data In 3</b> |
| <b>ACBITCLK</b>                     | J3           | I          | <b>AC97 Bit Clock</b>        |

| <b>Game Port Interface</b> |              |            |                            |
|----------------------------|--------------|------------|----------------------------|
| <b>Signal Name</b>         | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>  |
| <b>JAX / GAMED0</b>        | G5           | I          | <b>Joystick A X-axis</b>   |
| <b>JAY / GAMED1</b>        | H5           | I          | <b>Joystick A Y-axis</b>   |
| <b>JBX / GAMED2</b>        | K5           | I          | <b>Joystick B X-axis</b>   |
| <b>JBY / GAMED3</b>        | J5           | I          | <b>Joystick B Y-axis</b>   |
| <b>JAB1 / GAMED4</b>       | G3           | I          | <b>Joystick A Button 1</b> |
| <b>JAB2 / GAMED5</b>       | K4           | I          | <b>Joystick A Button 2</b> |
| <b>JBB1 / GAMED6</b>       | F1           | I          | <b>Joystick B Button 1</b> |
| <b>JBB2 / GAMED7</b>       | H4           | I          | <b>Joystick B Button 2</b> |

See Function 0 Rx77[6]

| Floppy Disk Interface |       |     |                                                                                                                        |
|-----------------------|-------|-----|------------------------------------------------------------------------------------------------------------------------|
| Signal Name           | Pin # | I/O | Signal Description                                                                                                     |
| <b>DRV DEN0</b>       | L17   | OD  | <b>Drive Density Select 0.</b>                                                                                         |
| <b>DRV DEN1</b>       | K17   | OD  | <b>Drive Density Select 1.</b>                                                                                         |
| <b>MTR0#</b>          | K18   | OD  | <b>Motor Control 0.</b> Select motor on drive 0.                                                                       |
| <b>MTR1#</b>          | J16   | OD  | <b>Motor Control 1.</b> Select motor on drive 1                                                                        |
| <b>DS0#</b>           | J17   | OD  | <b>Drive Select 0.</b> Select drive 0.                                                                                 |
| <b>DS1#</b>           | K19   | OD  | <b>Drive Select 1.</b> Select drive 1                                                                                  |
| <b>DIR#</b>           | K20   | OD  | <b>Direction.</b> Direction of head movement (0 = inward motion, 1 = outward motion)                                   |
| <b>STEP#</b>          | J18   | OD  | <b>Step.</b> Low pulse for each track-to-track movement of the head.                                                   |
| <b>INDEX#</b>         | L20   | I   | <b>Index.</b> Sense to detect that the head is positioned over the beginning of a track                                |
| <b>HDSEL#</b>         | H19   | OD  | <b>Head Select.</b> Selects the side for R/W operations (0 = side 1, 1 = side 0)                                       |
| <b>TRK00#</b>         | H16   | I   | <b>Track 0.</b> Sense to detect that the head is positioned over track 0.                                              |
| <b>RDATA#</b>         | H20   | I   | <b>Read Data.</b> Raw serial bit stream from the drive for read operations.                                            |
| <b>WDATA#</b>         | J19   | OD  | <b>Write Data.</b> Encoded data to the drive for write operations.                                                     |
| <b>WGATE#</b>         | J20   | OD  | <b>Write Gate.</b> Signal to the drive to enable current flow in the write head.                                       |
| <b>DSKCHG#</b>        | H18   | I   | <b>Disk Change.</b> Sense that the drive door is open or the diskette has been changed since the last drive selection. |
| <b>WRTprt#</b>        | H17   | I   | <b>Write Protect.</b> Sense for detection that the diskette is write protected (causes write commands to be ignored)   |

See also Parallel Port pin descriptions for optional Floppy Disk interface functionality



| Parallel Port Interface                                                                                                   |                                                      |                                                                              |                                                                                                                                        |  |
|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--|
| Signal Name                                                                                                               | Pin #                                                | I/O                                                                          | Signal Description                                                                                                                     |  |
| PINIT# / DIR#                                                                                                             | B12                                                  | IO / O                                                                       | <b>Initialize.</b> Initialize printer. Output in standard mode, I/O in ECP/EPP mode.                                                   |  |
| STROBE# / nc                                                                                                              | A11                                                  | IO / -                                                                       | <b>Strobe.</b> Output used to strobe data into the printer. I/O in ECP/EPP mode.                                                       |  |
| AUTOFD# / DRVEN0                                                                                                          | E11                                                  | IO / O                                                                       | <b>Auto Feed.</b> Output used to cause the printer to automatically feed one line after each line is printed. I/O pin in ECP/EPP mode. |  |
| SLCTIN# / STEP#                                                                                                           | D12                                                  | IO / O                                                                       | <b>Select In.</b> Output used to select the printer. I/O pin in ECP/EPP mode.                                                          |  |
| SLCT / WGATE#                                                                                                             | E13                                                  | I / O                                                                        | <b>Select.</b> Status output from the printer. High indicates that it is powered on.                                                   |  |
| ACK# / DS1#                                                                                                               | B14                                                  | I / O                                                                        | <b>Acknowledge.</b> Status output from the printer. Low indicates that it has received the data and is ready to accept new data        |  |
| ERROR# / HDSEL#                                                                                                           | F11                                                  | I / O                                                                        | <b>Error.</b> Status output from the printer. Low indicates an error condition in the printer.                                         |  |
| BUSY / MTR1#                                                                                                              | A14                                                  | I / O                                                                        | <b>Busy.</b> Status output from the printer. High indicates not ready to accept data.                                                  |  |
| PE / WDATA#                                                                                                               | D13                                                  | I / O                                                                        | <b>Paper End.</b> Status output from the printer. High indicates that it is out of paper.                                              |  |
| PD7 / nc,<br>PD6 / nc,<br>PD5 / nc,<br>PD4 / DSKCHG#,<br>PD3 / RDATA#,<br>PD2 / WRTprt#,<br>PD1 / TRK00#,<br>PD0 / INDEX# | C14<br>A13<br>B13<br>C13<br>E12<br>A12<br>C12<br>D11 | IO / -<br>IO / -<br>IO / -<br>IO / I<br>IO / I<br>IO / I<br>IO / I<br>IO / I | Parallel Port Data.                                                                                                                    |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |
|                                                                                                                           |                                                      |                                                                              |                                                                                                                                        |  |

As shown by the alternate functions above, in mobile applications the parallel port pins can optionally be selected to function as a floppy disk interface for attachment of an external floppy drive using the parallel port connector (see Super I/O Configuration Index F6[5]).

| Serial Port and Infrared Interface |       |       |                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------|-------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name                        | Pin # | I/O   | Signal Description                                                                                                                                                                                                                                                                                                                    |
| <b>TXD</b>                         | B15   | O     | <b>Transmit Data.</b> Serial port transmit data out.                                                                                                                                                                                                                                                                                  |
| <b>RXD</b>                         | E14   | I     | <b>Receive Data.</b> Serial port receive data in.                                                                                                                                                                                                                                                                                     |
| <b>IRTX / GPO14</b>                | R8    | O / O | <b>Infrared Transmit.</b> IR transmit data out (Rx76[5] = 0) selectable from serial port 1, 2, or 3. General Purpose Output 14 if Rx76[5] = 1                                                                                                                                                                                         |
| <b>IRRX / GPO15</b>                | U8    | I / O | <b>Infrared Receive.</b> IR receive data in (Rx76[5] = 0) selectable to serial port 1, 2, or 3. General Purpose Output 15 if Rx76[5] = 1                                                                                                                                                                                              |
| <b>IRRX2 / GPI</b>                 | T8    | I / I | <b>Infrared Receive.</b> IR receive data in (Rx76[5] = 0)                                                                                                                                                                                                                                                                             |
| <b>RTS#</b>                        | A15   | O     | <b>Request To Send.</b> Indicator that the serial output port is ready to transmit data. Typically used as hardware handshake with CTS# for low level flow control. Designed for direct input to external RS-232C driver.                                                                                                             |
| <b>CTS#</b>                        | B16   | I     | <b>Clear To Send.</b> Indicator to the serial port that an external communications device is ready to receive data. Typically used as hardware handshake with RTS# for low level flow control. Designed for input from external RS-232C receiver.                                                                                     |
| <b>DTR#</b>                        | A16   | O     | <b>Data Terminal Ready.</b> Indicator that serial port is powered, initialized, and ready. Typically used as hardware handshake with DSR# for overall readiness to communicate. Designed for direct input to external RS-232C driver.                                                                                                 |
| <b>DSR#</b>                        | D14   | I     | <b>Data Set Ready.</b> Indicator to serial port that an external serial communications device is powered, initialized, and ready. Typically used as hardware handshake with DTR# for overall readiness to communicate. Designed for direct input from external RS-232C receiver.                                                      |
| <b>DCD#</b>                        | F14   | I     | <b>Data Carrier Detect.</b> Indicator to serial port that an external modem is detecting a carrier signal (i.e., a communications channel is currently open). In direct connect environments, this input will typically be driven by DTR# as part of the DTR/DSR handshake. Designed for direct input from external RS-232C receiver. |
| <b>RI#</b>                         | C16   | I     | <b>Ring Indicator.</b> Indicator to serial port that an external modem is detecting a ring condition. Used by software to initiate operations to answer and open the communications channel. Designed for direct input from external RS-232C receiver (whose input is typically not connected in direct connect environments).        |

| <b>Conventional BIOS ROM / ISA Bus Interface</b>                                                                                                                                                                                                                                                                                                                                               |                                                                                                                      |                                                                                                                                                              |                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Signal Name</b>                                                                                                                                                                                                                                                                                                                                                                             | <b>Pin #</b>                                                                                                         | <b>I/O</b>                                                                                                                                                   | <b>Signal Description</b>                                                                                                                                                                                                                                                 |
| <b>LA21</b> / USB0C3# / GPO21<br><b>LA20</b> / USB0C2# / GPO20                                                                                                                                                                                                                                                                                                                                 | Y13<br>W13                                                                                                           | O                                                                                                                                                            | <b>System Address Bus.</b> Allows access to physical memory devices (e.g., BIOS ROMs) up to 4 Mbytes.                                                                                                                                                                     |
| <b>SA[19:18]</b> ,<br><b>SA17</b> / strap,<br><b>SA16</b> / strap,<br><b>SA[15:0]</b> / SDD[15:0]                                                                                                                                                                                                                                                                                              | V13, U13,<br>T13,<br>Y14,<br>W18, V17, Y17, W16,<br>V15, Y15, W14, T15,<br>U15, U16, V14, W15,<br>Y16, V16, W17, Y18 | IO                                                                                                                                                           | <b>System Address Bus.</b> These address lines are used to interface to BIOS ROMs but may also be used to implement a subset of the ISA bus if required. SA[19-16] are connected to ISA bus SA[19-16] directly. SA[19-17] are also connected to LA[19-17] of the ISA bus. |
| <b>SD15</b> / LGNT2# / GPO11,<br><b>SD14</b> / LREQ2# / GPI13,<br><b>SD13</b> / LGNT1# / GPO10,<br><b>SD12</b> / LREQ1# / GPI12,<br><b>SD11</b> / HGNT2# / GPO9,<br><b>SD10</b> / HREQ2# / GPI11,<br><b>SD9</b> / HGNT1# / GPO8,<br><b>SD8</b> / HREQ1# / GPI10,<br><b>SD7</b> ,<br><b>SD6</b> ,<br><b>SD5</b> ,<br><b>SD4</b> ,<br><b>SD3</b> ,<br><b>SD2</b> ,<br><b>SD1</b> ,<br><b>SD0</b> | V10<br>W10<br>Y10<br>U10<br>T10<br>V11<br>W11<br>Y11<br>T11<br>R11<br>U11<br>U12<br>Y12<br>W12<br>V12<br>R12         | IO / O / O<br>IO / I / I<br>IO / O / O<br>IO / I / I<br>IO / O / O<br>IO / I / I<br>IO / O / O<br>IO / I / I<br>IO<br>IO<br>IO<br>IO<br>IO<br>IO<br>IO<br>IO | <b>System Data.</b> SD[15:0] provide the data path for BIOS ROMs and for devices residing on the ISA bus. SD0-7 also output general purpose output information when GPOWE# is active.                                                                                     |
| <b>IOR#</b> / GPO22                                                                                                                                                                                                                                                                                                                                                                            | U7                                                                                                                   | IO                                                                                                                                                           | <b>I/O Read.</b> IOR# is the command to an ISA I/O slave device that the slave may drive data on to the ISA data bus.                                                                                                                                                     |
| <b>IOW#</b> / GPO23                                                                                                                                                                                                                                                                                                                                                                            | T7                                                                                                                   | IO                                                                                                                                                           | <b>I/O Write.</b> IOW# is the command to an ISA I/O slave device that the slave may latch data from the ISA data bus.                                                                                                                                                     |
| <b>MEMR#</b>                                                                                                                                                                                                                                                                                                                                                                                   | W9                                                                                                                   | IO                                                                                                                                                           | <b>Memory Read.</b> MEMR# is the command to a memory slave that it may drive data onto the ISA data bus.                                                                                                                                                                  |
| <b>MEMW#</b>                                                                                                                                                                                                                                                                                                                                                                                   | Y9                                                                                                                   | IO                                                                                                                                                           | <b>Memory Write.</b> MEMW# is the command to a memory slave that it may latch data from the ISA data bus.                                                                                                                                                                 |
| <b>IRQ1</b> / MSCK                                                                                                                                                                                                                                                                                                                                                                             | N2                                                                                                                   | I / IO                                                                                                                                                       | <b>Interrupt 1 (optional external Keyboard Controller).</b>                                                                                                                                                                                                               |
| <b>IRQ8#</b> / GPI1                                                                                                                                                                                                                                                                                                                                                                            | V3                                                                                                                   | I / I                                                                                                                                                        | <b>Interrupt 8 (optional external RTC).</b>                                                                                                                                                                                                                               |
| <b>IRQ12</b> / MSDT                                                                                                                                                                                                                                                                                                                                                                            | N4                                                                                                                   | I / IO                                                                                                                                                       | <b>Interrupt 12 (optional external PS2 Mouse Controller).</b>                                                                                                                                                                                                             |
| <b>IRQ14</b>                                                                                                                                                                                                                                                                                                                                                                                   | T14                                                                                                                  | I                                                                                                                                                            | <b>Interrupt 14 (IDE Primary Channel).</b>                                                                                                                                                                                                                                |
| <b>IRQ15</b>                                                                                                                                                                                                                                                                                                                                                                                   | U14                                                                                                                  | I                                                                                                                                                            | <b>Interrupt 15 (IDE Secondary Channel).</b>                                                                                                                                                                                                                              |
| <b>SPKR</b>                                                                                                                                                                                                                                                                                                                                                                                    | U9                                                                                                                   | O                                                                                                                                                            | <b>Speaker Drive.</b> Output of internal timer/counter 2.                                                                                                                                                                                                                 |

| <b>Serial IRQ</b>  |              |            |                                                 |
|--------------------|--------------|------------|-------------------------------------------------|
| <b>Signal Name</b> | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>                       |
| <b>SERIRQ</b>      | V9           | I          | <b>Serial IRQ</b> (Rx68[3] = 1 and Rx74[6] = 0) |

| Internal Keyboard Controller |       |           |                                                                                                                                                                                                                                                       |
|------------------------------|-------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name                  | Pin # | I/O       | Signal Description                                                                                                                                                                                                                                    |
| MSCK / IRQ1                  | N2    | IO / I    | <b>MultiFunction Pin</b> (Internal mouse controller enabled by Rx5A[1])<br>Rx5A[1]=1 <b>Mouse Clock</b> . From internal mouse controller.<br>Rx5A[1]=0 <b>Interrupt Request 1</b> . Interrupt 1 (external KBC).                                       |
| MSDT / IRQ12                 | N4    | IO / I    | <b>MultiFunction Pin</b> (Internal mouse controller enabled by Rx5A[1])<br>Rx5A[1]=1 <b>Mouse Data</b> . From internal mouse controller.<br>Rx5A[1]=0 <b>Interrupt Request 12</b> . Interrupt 12 (ext PS2 mouse ctrl).                                |
| KBCK / A20GATE               | M4    | IO / I    | <b>MultiFunction Pin</b> (Internal keyboard controller enabled by Rx5A[0])<br>Rx5A[0]=1 <b>Keyboard Clock</b> . From internal keyboard controller<br>Rx5A[0]=0 <b>Gate A20</b> . Input from external keyboard controller.                             |
| KBDT / KBRC                  | N1    | IO / I    | <b>MultiFunction Pin</b> (Internal keyboard controller enabled by Rx5A[0])<br>Rx5A[0]=1 <b>Keyboard Data</b> . From internal keyboard controller.<br>Rx5A[0]=0 <b>Keyboard Reset</b> . From external keyboard controller (KBC) for CPURST# generation |
| KBCS# / ROMCS# / strap       | T9    | O / O / I | <b>Keyboard Chip Select</b> (Rx5A[0]=0). To external keyboard controller chip.                                                                                                                                                                        |

| Chip Selects             |       |             |                                                                                                                                                                                |
|--------------------------|-------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name              | Pin # | I/O         | Signal Description                                                                                                                                                             |
| ROMCS# / KBCS# / strap   | T9    | O / O / I   | <b>ROM Chip Select</b> (Rx5A[0]=1). Chip Select to the BIOS ROM.                                                                                                               |
| MCCS# / GPO17 / strap    | W6    | O / IO      | <b>Microcontroller Chip Select</b> (Rx76[3] = 1, Rx76[4] = 0, Rx77[0] = 1). Asserted during read or write accesses to I/O ports 62h or 66h.                                    |
| PCS0# / GPO16 / strap    | Y6    | O / IO / IO | <b>Programmable Chip Select 0</b> . (Rx76[1] = 1 and Rx8B[0] = 1). Asserted during I/O cycles to programmable read or write ISA I/O port ranges. See also Rx59[3] and Rx77[2]. |
| PCS1# / ACSDIN2 / GPIO19 | J1    | O / I / IO  | <b>Programmable Chip Select 1</b> .                                                                                                                                            |

| General Purpose Inputs                         |       |                    |                                              |
|------------------------------------------------|-------|--------------------|----------------------------------------------|
| Signal Name                                    | Pin # | I/O                | Signal Description                           |
| <b>GPI0</b>                                    | F4    | I                  | <b>General Purpose Input 0</b>               |
| <b>GPI1</b> / IRQ8#                            | V3    | I / I              | <b>General Purpose Input 1</b> (Rx5A[2] = 1) |
| <b>GPI2</b> / EXTSMI#                          | T4    | I / IO             | <b>General Purpose Input 2</b>               |
| <b>GPI3</b> / RING#                            | U3    | I / I              | <b>General Purpose Input 3</b>               |
| <b>GPI4</b> / LID                              | Y2    | I / I              | <b>General Purpose Input 4</b>               |
| <b>GPI5</b> / BATLOW#                          | T3    | I / I              | <b>General Purpose Input 5</b>               |
| <b>GPI6</b> / PME#                             | U1    | I / I              | <b>General Purpose Input 6</b>               |
| <b>GPI7</b> / SMBALRT#                         | T2    | I / I              | <b>General Purpose Input 7</b>               |
| <b>GPI8</b> / INTRUDER#                        | F3    | I / I              | <b>General Purpose Input 8</b>               |
| <b>GPI9</b> / APICCLK                          | Y3    | I / I              | <b>General Purpose Input 9</b>               |
| <b>GPI10</b> / SD8 / HREQ1#                    | Y11   | I / IO / I         | <b>General Purpose Input 10</b>              |
| <b>GPI11</b> / SD10 / HREQ2#                   | W11   | I / IO / I         | <b>General Purpose Input 11</b>              |
| <b>GPI12</b> / SD12 / LREQ1#                   | U10   | I / IO / I         | <b>General Purpose Input 12</b>              |
| <b>GPI13</b> / SD14 / LREQ2#                   | W10   | I / IO / I         | <b>General Purpose Input 13</b>              |
| <b>GPI14</b> / WSC# / APICREQ#                 | V4    | I / I / I          | <b>General Purpose Input 14</b>              |
| <b>GPI15</b> / LDRQ# / ACSDIN3                 | Y8    | I / I / I          | <b>General Purpose Input 15</b>              |
| <b>GPI16</b> / CPUMISS                         | R5    | I / I              | <b>General Purpose Input 16</b>              |
| <b>GPI17</b> / AOLGPI / THRM                   | P3    | I / I / I          | <b>General Purpose Input 17</b>              |
| <b>GPI18</b> / GPO18 / FAN2 / SLPBTN#          | K3    | I / O / I / I      | <b>General Purpose Input 18</b>              |
| <b>GPI19</b> / GPO19 / ACSDIN2 / PCS1#         | J1    | I / O / I / O      | <b>General Purpose Input 19</b>              |
| <b>GPI20</b>                                   |       |                    | <b>General Purpose Input 20</b>              |
| <b>GPI21</b>                                   |       |                    | <b>General Purpose Input 21</b>              |
| <b>GPI22</b>                                   |       |                    | <b>General Purpose Input 22</b>              |
| <b>GPI23</b>                                   |       |                    | <b>General Purpose Input 23</b>              |
| <b>GPI24</b> / GPO24 / GPIOA                   | V2    | I / O / IO         | <b>General Purpose Input 24</b>              |
| <b>GPI25</b> / GPO25 / GPIOC / ATEST           | J2    | I / O / IO / O     | <b>General Purpose Input 25</b>              |
| <b>GPI26</b> / GPO26 / SMBDT2                  | R2    | I / O / IO         | <b>General Purpose Input 26</b>              |
| <b>GPI27</b> / GPO27 / SMBCK2                  | R1    | I / O / IO         | <b>General Purpose Input 27</b>              |
| <b>GPI28</b> / GPO28 / APICD0 / APICCS#        | W4    | I / O / O / O      | <b>General Purpose Input 28</b>              |
| <b>GPI29</b> / GPO29 / APICD1 / APICACK#       | Y4    | I / O / O / O      | <b>General Purpose Input 29</b>              |
| <b>GPI30</b> / GPO30 / GPIOD / DTEST / SCIOUT# | Y1    | I / O / IO / O / O | <b>General Purpose Input 30</b>              |
| <b>GPI31</b> / GPO31 / GPIOE                   | W3    | I / O / IO         | <b>General Purpose Input 31</b>              |

| <b>General Purpose Outputs</b>                 |              |                    |                                                                                                      |
|------------------------------------------------|--------------|--------------------|------------------------------------------------------------------------------------------------------|
| <b>Signal Name</b>                             | <b>Pin #</b> | <b>I/O</b>         | <b>Signal Description</b>                                                                            |
| <b>GPO0 / SLOWCLK</b>                          | R4           | O / O              | <b>General Purpose Output 0.</b> (Func 4 Rx54[1-0] = 00). Output value determined by PMU I/O Rx4C[0] |
| <b>GPO1 / SUSA#</b>                            | P1           | O / O              | <b>General Purpose Output 1.</b>                                                                     |
| <b>GPO2 / SUSB#</b>                            | P2           | O / O              | <b>General Purpose Output 2.</b>                                                                     |
| <b>GPO3 / SUSST1#</b>                          | N5           | O / O              | <b>General Purpose Output 3.</b>                                                                     |
| <b>GPO4 / SUSCLK</b>                           | P4           | O / O              | <b>General Purpose Output 4.</b>                                                                     |
| <b>GPO5 / CPUTP#</b>                           | W2           | O / O              | <b>General Purpose Output 5.</b>                                                                     |
| <b>GPO6 / PCISTP#</b>                          | W1           | O / O              | <b>General Purpose Output 6.</b>                                                                     |
| <b>GPO7 / SLP#</b>                             | U6           | O / O              | <b>General Purpose Output 7.</b>                                                                     |
| <b>GPO8 / SD9 / HGNT1#</b>                     | W11          | O / IO / O         | <b>General Purpose Output 8.</b>                                                                     |
| <b>GPO9 / SD11 / HGNT2#</b>                    | T10          | O / IO / O         | <b>General Purpose Output 9.</b>                                                                     |
| <b>GPO10 / SD13 / LGNT1#</b>                   | Y10          | O / IO / O         | <b>General Purpose Output 10.</b>                                                                    |
| <b>GPO11 / SD15 / LGNT2#</b>                   | V10          | O / IO / O         | <b>General Purpose Output 11.</b>                                                                    |
| <b>GPO12</b>                                   |              |                    | <b>General Purpose Output 12.</b>                                                                    |
| <b>GPO13</b>                                   |              |                    | <b>General Purpose Output 13.</b>                                                                    |
| <b>GPO14 / IRTX</b>                            | R8           | O / O              | <b>General Purpose Output 14</b> (Rx76[5] = 1)                                                       |
| <b>GPO15 / IRRX</b>                            | U8           | O / I              | <b>General Purpose Output 15</b> (Rx76[5] = 1)                                                       |
| <b>GPO16 / PCS0#</b>                           | Y6           | O / O              | <b>General Purpose Output 16.</b>                                                                    |
| <b>GPO17 / MCCS#</b>                           | W6           | O / O              | <b>General Purpose Output 17.</b>                                                                    |
| <b>GPO18 / GPI18 / FAN2 / SLPBTN#</b>          | K3           | O / I / I / I      | <b>General Purpose Output 18.</b>                                                                    |
| <b>GPO19 / GPI19 / PCS1# / ACSDIN2</b>         | J1           | O / I / O / I      | <b>General Purpose Output 19.</b>                                                                    |
| <b>GPO20 / LA20 / USB0C2#</b>                  | W13          | O / IO / I         | <b>General Purpose Output 20.</b>                                                                    |
| <b>GPO21 / LA21 / USB0C3#</b>                  | Y13          | O / IO / I         | <b>General Purpose Output 21.</b>                                                                    |
| <b>GPO22 / IOR#</b>                            | U7           | O / O              | <b>General Purpose Output 22.</b>                                                                    |
| <b>GPO23 / IOW#</b>                            | T7           | O / O              | <b>General Purpose Output 23.</b>                                                                    |
| <b>GPO24 / GPI24 / GPIOA</b>                   | V2           | O / I / IO         | <b>General Purpose Output 24.</b>                                                                    |
| <b>GPO25 / GPI25 / GPIOC / ATEST</b>           | J2           | O / I / IO / O     | <b>General Purpose Output 25.</b>                                                                    |
| <b>GPO26 / GPI26 / SMBDT2</b>                  | R2           | O / I / IO         | <b>General Purpose Output 26.</b>                                                                    |
| <b>GPO27 / GPI27 / SMBCK2</b>                  | R1           | O / I / IO         | <b>General Purpose Output 27.</b>                                                                    |
| <b>GPO28 / GPI28 / APICD0 / APICCS#</b>        | W4           | O / I / O / O      | <b>General Purpose Output 28.</b>                                                                    |
| <b>GPO29 / GPI29 / APICD1 / APICACK#</b>       | Y4           | O / I / O / O      | <b>General Purpose Output 29.</b>                                                                    |
| <b>GPO30 / GPI30 / GPIOD / DTEST / SCIOUT#</b> | Y1           | O / I / IO / O / O | <b>General Purpose Output 30.</b>                                                                    |
| <b>GPO31 / GPI31 / GPIOE</b>                   | W3           | O / I / IO         | <b>General Purpose Output 31.</b>                                                                    |

| General Purpose I/Os                           |       |                    |                                                                                          |
|------------------------------------------------|-------|--------------------|------------------------------------------------------------------------------------------|
| Signal Name                                    | Pin # | I/O                | Signal Description                                                                       |
| <b>GPIOA</b> / GPI24 / GPO24                   | V2    | IO / I / O         | <b>General Purpose I/O A / 24</b> (Rx76[0] = 0). GPOWE# if Rx76[0] = 1. See also Rx74[2] |
| <b>GPIOB</b>                                   |       |                    | <b>General Purpose I/O B</b>                                                             |
| <b>GPIOC</b> / GPI25 / GPO25 / ATEST           | J2    | IO / I / O / O     | <b>General Purpose I/O C / 25.</b> (Rx76[2] = 0). See also Rx74[4]                       |
| <b>GPIOD</b> / GPI30 / GPO30 / DTEST / SCIOUT# | Y1    | IO / I / O / O / O | <b>General Purpose I/O D / 30.</b> (Rx76[3] = 0). See also Rx74[5]                       |
| <b>GPIOE</b> / GPI31 / GPO31                   | W3    | IO                 | <b>General Purpose I/O E / 31.</b>                                                       |

| Hardware Monitoring                   |       |               |                                                                       |
|---------------------------------------|-------|---------------|-----------------------------------------------------------------------|
| Signal Name                           | Pin # | I/O           | Signal Description                                                    |
| <b>UIC1</b>                           | M1    | Analog I      | <b>Universal Input Channel.</b> For temperature / voltage monitoring. |
| <b>UIC2</b>                           | M3    | Analog I      | <b>Universal Input Channel.</b> For temperature / voltage monitoring. |
| <b>UIC3</b>                           | M2    | Analog I      | <b>Universal Input Channel.</b> For temperature / voltage monitoring. |
| <b>UIC4</b>                           | L4    | Analog I      | <b>Universal Input Channel.</b> For temperature / voltage monitoring. |
| <b>UIC5</b>                           | L1    | Analog I      | <b>Universal Input Channel.</b> For temperature / voltage monitoring. |
| <b>DTD+</b>                           | L2    | Analog I      | <b>CPU DTD (Thermal Diode) Channel Plus.</b>                          |
| <b>DTD-</b>                           | L3    | Analog I      | <b>CPU DTD (Thermal Diode) Channel Minus.</b>                         |
| <b>VREF</b>                           | K1    | P             | <b>Voltage Reference for Thermal Sensing</b> (5V $\pm$ 5%)            |
| <b>FAN1</b>                           | K2    | I             | <b>Fan Speed Monitor 1.</b> (3.3V only)                               |
| <b>FAN2</b> / SLPBTN# / GPI18 / GPO18 | K3    | I / I / I / O | <b>Fan Speed Monitor 2.</b> (3.3V only)                               |
| <b>DTEST</b> / GPIOD (30) / SCIOUT#   | Y1    | O             | <b>Hardware Monitor Digital Test Out</b>                              |
| <b>ATEST</b> / GPIOC (25)             | J2    | O             | <b>Hardware Monitor Analog Test Out</b>                               |

| <b>Power Management and External State Monitoring</b> |              |            |                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------|--------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Signal Name</b>                                    | <b>Pin #</b> | <b>I/O</b> | <b>Signal Description</b>                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>PME# / GPI6</b>                                    | U1           | I / I      | <b>Power Management Event.</b> (Rx74[1]=0) (1K PU to VCCS if not used)                                                                                                                                                                                                                                                                                                                                     |
| <b>EXTSMI# / GPI2</b>                                 | T4           | IOD / I    | <b>External System Management Interrupt.</b> When enabled to allow it, a falling edge on this input causes an SMI# to be generated to the CPU to enter SMI mode. (10K PU to VCCS if not used) (3.3V only)                                                                                                                                                                                                  |
| <b>SMBALRT# / GPI7</b>                                | T2           | I / I      | <b>SMB Alert</b> (System Management Bus I/O space Rx08[3] = 1). When the chip is enabled to allow it, assertion generates an IRQ or SMI or power management event. (10K PU to VCCS if not used)                                                                                                                                                                                                            |
| <b>THRM / AOLGPI / GPI17</b>                          | P3           | I / I / I  | <b>Monitor Input - Thermal Alarm.</b> (Rx74[1]=1) (1K PU to VCCS if not used)                                                                                                                                                                                                                                                                                                                              |
| <b>LID / GPI4</b>                                     | Y2           | I / I      | <b>Monitor Input - Notebook Computer Display Lid Open / Closed.</b> Used by the Power Management subsystem to monitor the opening and closing of the display lid of notebook computers. Can be used to detect either low-to-high and/or high-to-low transitions to generate an SMI#. The VT8231 performs a 200 usec debounce of this input if Function 4 Rx40[5] is set to 1. (10K PU to VCCS if not used) |
| <b>RING# / GPI3</b>                                   | U3           | I / I      | <b>Monitor Input – Modem Ring.</b> May be connected to external modem circuitry to allow the system to be re-activated by a received phone call. (10K PU to VCCS if not used)                                                                                                                                                                                                                              |
| <b>BATLOW# / GPI5</b>                                 | T3           | I / I      | <b>Monitor Input - Battery Low.</b> (10K PU to VCCS if not used)                                                                                                                                                                                                                                                                                                                                           |
| <b>CPUMISS / GPI16</b>                                | R5           | I / I      | <b>Monitor Input - CPU Missing.</b> Indicates whether the CPU is plugged in correctly.                                                                                                                                                                                                                                                                                                                     |
| <b>AOLGPI / GPI17 / THRM</b>                          | P3           | I / I / I  | <b>Monitor Input - Awake On LAN External Event.</b>                                                                                                                                                                                                                                                                                                                                                        |
| <b>INTRUDER# / GPI8</b>                               | F3           | I / I      | <b>Monitor Input – Chassis Intrusion.</b>                                                                                                                                                                                                                                                                                                                                                                  |
| <b>RSMRST#</b>                                        | F5           | I          | <b>Resume Reset.</b> Resets the internal logic connected to the VCCS power plane and also resets portions of the internal RTC logic.                                                                                                                                                                                                                                                                       |
| <b>SUSA# / GPO1 / strap</b>                           | P1           | O / O / I  | <b>Suspend Plane A Control</b> (Rx74[7]=0 and Function 4 Rx54[2]=0). Asserted during power management POS, STR, and STD suspend states. Used to control the primary power plane. (10K PU to VCCS if not used)                                                                                                                                                                                              |
| <b>SUSB# / GPO2</b>                                   | P2           | O / O      | <b>Suspend Plane B Control</b> (Rx74[7]=0 and Function 4 Rx54[3]=0). Asserted during power management STR and STD suspend states. Used to control the secondary power plane. (10K PU to VCCS if not used)                                                                                                                                                                                                  |
| <b>SUSC# / GPO</b>                                    | N3           | O / O      | <b>Suspend Plane C Control.</b> Asserted during power management STD suspend state. Used to control the tertiary power plane. Also connected to ATX power-on circuitry.                                                                                                                                                                                                                                    |
| <b>SUSST1# / GPO3</b>                                 | N5           | O / O      | <b>Suspend Status 1</b> (Func4 Rx54[4] = 1 for GPO3). Typically connected to the North Bridge to provide information on host clock status. Asserted when the system may stop the host clock, such as Stop Clock or during POS, STR, or STD suspend states. Connect 10K PU to VCCS.                                                                                                                         |
| <b>SUSCLK / GPO4</b>                                  | P4           | O / O      | <b>Suspend Clock.</b> 32.768 KHz output clock for use by the North Bridge (e.g., Apollo MVP3 or MVP4) for DRAM refresh purposes. Stopped during Suspend-to-Disk and Soft-Off modes. Connect 10K PU to VCCS.                                                                                                                                                                                                |



| Resets, Clocks, and Clock Control |       |            |                                                                                                                                                                                                                      |
|-----------------------------------|-------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal Name                       | Pin # | I/O        | Signal Description                                                                                                                                                                                                   |
| <b>PWRGD</b>                      | E3    | I          | <b>Power Good.</b> Connected to the PWRGOOD signal on the Power Supply.                                                                                                                                              |
| <b>PWRBTN#</b>                    | U2    | I          | <b>Power Button.</b> Used by the Power Management subsystem to monitor an external system on/off button or switch. The VT8231 performs a 200us debounce of this input if Function 4 Rx40[5] is set to 1. (3.3V only) |
| <b>SLPBTN# / FAN2 / GPIO18</b>    | K3    | I / I / IO | <b>Sleep Button.</b> Used by the power management subsystem to monitor an external system sleep button or switch (Function 4 Rx40[6] = 1). Connect to VCC if not used.                                               |
| <b>PCIRST#</b>                    | E4    | O          | <b>PCI Reset.</b> Active low reset signal for the PCI bus. The VT8231 will assert this pin during power-up or from the control register.                                                                             |
| <b>RTCX1</b>                      | E2    | I          | <b>RTC Crystal Input:</b> 32.768 KHz crystal or oscillator input. This input is used for the internal RTC and for power-well power management logic.                                                                 |
| <b>RTCX2</b>                      | E1    | O          | <b>RTC Crystal Output:</b> 32.768 KHz crystal output                                                                                                                                                                 |
| <b>OSC</b>                        | T12   | I          | <b>Oscillator.</b> 14.31818 MHz clock signal used by the internal Timer.                                                                                                                                             |
| <b>SLOWCLK / GPO0</b>             | R4    | O          | <b>Slow Clock.</b> Frequency selectable if PMU function 4 Rx54[1-0] is nonzero (set to 01, 10, or 11).                                                                                                               |
| <b>CPUSTP# / GPO5</b>             | W2    | O / O      | <b>CPU Clock Stop</b> (Rx75[4] = 0). Signals the system clock generator to disable the CPU clock outputs. Not connected if not used. See also PMU I/O Rx2C[3].                                                       |
| <b>PCISTP# / GPO6</b>             | W1    | O / O      | <b>PCI Clock Stop</b> (Rx75[5] = 0). Signals the system clock generator to disable the PCI clock outputs. Not connected if not used.                                                                                 |

| <b>Power and Ground</b> |                                                                                                                    |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|--------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Signal Name</b>      | <b>Pin #</b>                                                                                                       | <b>I/O</b> | <b>Signal Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>VCC</b> (27 Pins)    | F7, F9, F12-F13, F15, G6, G8-G10, G12, H6, J6, J15, K15, L6, M6, M15, N6, P8-P9, P11-P13, P15, R7, R9-R10, R13-R15 | P          | <b>Core Power.</b> 3.3V nominal (3.15V to 3.45V). This supply is turned on only when the mechanical switch on the power supply is turned on and the PWRON signal is conditioned high. These pins should be connected to the same voltage as the CPU I/O circuitry. Internally connected to hardware monitoring system voltage detection circuitry for 3.3V monitoring.                                                                                                                                                                                |
| <b>GND</b> (27 Pins)    | G7, G11, G14, H15, J8-J13, K6, K8-K13, L8-L13, L15, M8-M13, N15, P7, P10, P14                                      | P          | <b>Ground.</b> Connect to primary motherboard ground plane.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>VCCSUS</b>           | P5, P6                                                                                                             | P          | <b>Suspend Power.</b> Always available unless the mechanical switch of the power supply is turned off. If the “soft-off” state is not implemented, then this pin can be connected to VCC. Signals powered by or referenced to this plane are: SMBCK1/DT1, KBCK/DT, MSCK/DT, PWRBTN#, SUSC#, GPO0 / SLOWCLK, GPO1 / SUSA#, GPO2 / SUSB#, GPO3 / SUSST1#, GPO4 / SUSCLK, GPI1 / IRQ8#, GPI2 / EXTSMI#, GPI3 / RING#, GPI4 / LID, GPI5 / BATLOW#, GPI6 / PME#, GPI7 / SMBALRT#, GPI16 / CPUMISS, GPI17 / AOLGPI / THRM, GPIO26 / SMBDT2, GPIO27 / SMBCK2 |
| <b>VBAT</b>             | F2                                                                                                                 | P          | <b>RTC Battery.</b> Battery input for internal RTC. Signals powered by or referenced to this plane are: RTCX1, RTCX2, PWRGD, RSMRST#, GPIO, and INTRUDER#.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>VREF</b>             | K1                                                                                                                 | P          | <b>Voltage Reference</b> (5V $\pm$ 5%). For thermal sensing and 5V input tolerance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>VCCHWM</b>           | M5                                                                                                                 | P          | <b>Hardware Monitor Power.</b> Power for hardware monitoring subsystem (voltage monitoring, temperature monitoring, and fan speed monitoring). Connect to VCC through a ferrite bead. Signals powered by or referenced to this plane are: UIC[5:1], DTD+/-, FAN1, FAN2 / SLPBTN# / GPIO18                                                                                                                                                                                                                                                             |
| <b>GNDHWM</b>           | L5                                                                                                                 | P          | <b>Hardware Monitor Ground.</b> Connect to GND through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>VCCMII</b>           | F16, K16                                                                                                           | P          | <b>LAN MII Power.</b> Power for LAN Media Independent Interface (interface to external PHY). Connect to VCC through a ferrite bead. Signals powered by or referenced to this plane are: MCRS, MCOL, MDCK, MDIO, MTXD[3:0], MTXENA, MTXCLK, MRXERR, MRXCLK, MRXDV, and MRXD[3:0]                                                                                                                                                                                                                                                                       |
| <b>VCCRAM</b>           | G15                                                                                                                | P          | <b>LAN RAM Power.</b> Power for LAN internal RAM. Connect to VCC through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>GNDRAM</b>           | G13                                                                                                                | P          | <b>LAN RAM Ground.</b> Connect to GND through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>VCCPLL</b>           | L16                                                                                                                | P          | <b>PLL Power.</b> Power for internal PLL. Connect to VCC through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>GNDPLL</b>           | M16                                                                                                                | P          | <b>PLL Ground.</b> Connect to GND through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>VCCUSB</b>           | E15                                                                                                                | P          | <b>USB Differential Output Power.</b> Power for USB differential outputs (USBP0+, P0-, P1+, P1-, P2+, P2-, P3+, P3-). Connect to VCC through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>GNDUSB</b>           | D15                                                                                                                | P          | <b>USB Differential Output Ground.</b> Connect to GND through a ferrite bead.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

# REGISTERS

## Register Overview

The following tables summarize the configuration and I/O registers of the VT8231. These tables also document the power-on default value ("Default") and access type ("Acc") for each register. Access type definitions used are RW (Read/Write), RO (Read/Only), "—" for reserved / used (essentially the same as RO), and RWC (or just WC) (Read / Write 1's to Clear individual bits). Registers indicated as RW may have some read-only bits that always read back a fixed value (usually 0 if unused); registers designated as RWC or WC may have some read-only or read write bits (see individual register descriptions for details).

Detailed register descriptions are provided in the following section of this document. All offset and default values are shown in hexadecimal unless otherwise indicated

**Table 2. System I/O Map**

| <u>Port</u> | <u>Function</u>             | <u>Actual Port Decoding</u> |
|-------------|-----------------------------|-----------------------------|
| 00-1F       | Master DMA Controller       | 0000 0000 000x nnnn         |
| 20-3F       | Master Interrupt Controller | 0000 0000 001x xxxn         |
| 40-5F       | Timer / Counter             | 0000 0000 010x xxnn         |
| 60-6F       | Keyboard Controller         | 0000 0000 0110 xnnx         |
| (60h)       | KBC Data                    | 0000 0000 0110 x0x0         |
| (61h)       | Misc Functions & Spkr Ctrl  | 0000 0000 0110 xxx1         |
| (64h)       | KBC Command / Status        | 0000 0000 0110 x1x0         |
| 70-77       | RTC/CMOS/NMI-Disable        | 0000 0000 0111 0nnn         |
| 78-7F       | -available for system use-  | 0000 0000 0111 1xxx         |
| 80          | -reserved- (debug port)     | 0000 0000 1000 0000         |
| 81-8F       | DMA Page Registers          | 0000 0000 1000 nnnn         |
| 90-91       | -available for system use-  | 0000 0000 1001 000x         |
| 92          | System Control              | 0000 0000 1001 0010         |
| 93-9F       | -available for system use-  | 0000 0000 1001 nnnn         |
| A0-BF       | Slave Interrupt Controller  | 0000 0000 101x xxxn         |
| C0-DF       | Slave DMA Controller        | 0000 0000 110n nnnx         |
| E0-FF       | -available for system use-  | 0000 0000 111x xxxx         |
| 100-CF7     | -available for system use*  |                             |
| CF8-CFB     | PCI Configuration Address   | 0000 1100 1111 10xx         |
| CFC-CFF     | PCI Configuration Data      | 0000 1100 1111 11xx         |
| D00-FFFF    | -available for system use-  |                             |

\* On-Chip Super-I/O Functions – PC-Standard Port Addresses

|         |                                |
|---------|--------------------------------|
| 200-20F | Game Port                      |
| 2E8-2EF | COM4                           |
| 2F8-2FF | COM2                           |
| 378-37F | Parallel Port (Standard & EPP) |
| 3E8-3EF | COM3                           |
| 3F0-3F1 | Configuration Index / Data     |
| 3F0-3F7 | Floppy Controller              |
| 3F8-3FF | COM1                           |
| 400-402 | Parallel Port (ECP Extensions) |

**Table 3. Registers**
**Legacy I/O Registers**

| <b>Port</b> | <b>Master DMA Controller Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|----------------------------------------|----------------|------------|
| 00          | Channel 0 Base & Current Address       |                | RW         |
| 01          | Channel 0 Base & Current Count         |                | RW         |
| 02          | Channel 1 Base & Current Address       |                | RW         |
| 03          | Channel 1 Base & Current Count         |                | RW         |
| 04          | Channel 2 Base & Current Address       |                | RW         |
| 05          | Channel 2 Base & Current Count         |                | RW         |
| 06          | Channel 3 Base & Current Address       |                | RW         |
| 07          | Channel 3 Base & Current Count         |                | RW         |
| 08          | Status / Command                       |                | RW         |
| 09          | Write Request                          |                | WO         |
| 0A          | Write Single Mask                      |                | WO         |
| 0B          | Write Mode                             |                | WO         |
| 0C          | Clear Byte Pointer FF                  |                | WO         |
| 0D          | Master Clear                           |                | WO         |
| 0E          | Clear Mask                             |                | WO         |
| 0F          | Read / Write Mask                      |                | RW         |

| <b>Port</b> | <b>Master Interrupt Controller Regs</b> | <b>Default</b> | <b>Acc</b> |
|-------------|-----------------------------------------|----------------|------------|
| 20          | Master Interrupt Control                | —              | *          |
| 21          | Master Interrupt Mask                   | —              | *          |
| 20          | Master Interrupt Control Shadow         | —              | RW         |
| 21          | Master Interrupt Mask Shadow            | —              | RW         |

\* RW if shadow registers are disabled

| <b>Port</b> | <b>Timer/Counter Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|--------------------------------|----------------|------------|
| 40          | Timer / Counter 0 Count        |                | RW         |
| 41          | Timer / Counter 1 Count        |                | RW         |
| 42          | Timer / Counter 2 Count        |                | RW         |
| 43          | Timer / Counter Control        |                | WO         |

| <b>Port</b> | <b>Keyboard Controller Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|--------------------------------------|----------------|------------|
| 60          | Keyboard Controller Data             |                | RW         |
| 61          | Misc Functions & Speaker Control     |                | RW         |
| 64          | Keyboard Ctrlr Command / Status      |                | RW         |

| <b>Port</b> | <b>CMOS / RTC / NMI Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|-----------------------------------|----------------|------------|
| 70          | CMOS Memory Address & NMI Disa    |                | WO         |
| 71          | CMOS Memory Data (128 bytes)      |                | RW         |
| 72          | CMOS Memory Address               |                | RW         |
| 73          | CMOS Memory Data (256 bytes)      |                | RW         |
| 74          | CMOS Memory Address               |                | RW         |
| 75          | CMOS Memory Data (256 bytes)      |                | RW         |

NMI Disable is port 70h (CMOS Memory Address) bit-7.  
 RTC control occurs via specific CMOS data locations (0-Dh).  
 Ports 72-73 may be used to access all 256 locations of CMOS.  
 Ports 74-75 may be used to access CMOS if the internal RTC is disabled.

**Legacy I/O Registers (continued)**

| <b>Port</b> | <b>DMA Page Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|---------------------------|----------------|------------|
| 87          | DMA Page – DMA Channel 0  |                | RW         |
| 83          | DMA Page – DMA Channel 1  |                | RW         |
| 81          | DMA Page – DMA Channel 2  |                | RW         |
| 82          | DMA Page – DMA Channel 3  |                | RW         |
| 8F          | DMA Page – DMA Channel 4  |                | RW         |
| 8B          | DMA Page – DMA Channel 5  |                | RW         |
| 89          | DMA Page – DMA Channel 6  |                | RW         |
| 8A          | DMA Page – DMA Channel 7  |                | RW         |

| <b>Port</b> | <b>System Control Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|---------------------------------|----------------|------------|
| 92          | System Control                  |                | RW         |

| <b>Port</b> | <b>Slave Interrupt Controller Regs</b> | <b>Default</b> | <b>Acc</b> |
|-------------|----------------------------------------|----------------|------------|
| A0          | Slave Interrupt Control                | —              | *          |
| A1          | Slave Interrupt Mask                   | —              | *          |
| A0          | Slave Interrupt Control Shadow         | —              | RW         |
| A1          | Slave Interrupt Mask Shadow            | —              | RW         |

\* RW accessible if shadow registers are disabled

| <b>Port</b> | <b>Slave DMA Controller Registers</b> | <b>Default</b> | <b>Acc</b> |
|-------------|---------------------------------------|----------------|------------|
| C0          | Channel 0 Base & Current Address      |                | RW         |
| C2          | Channel 0 Base & Current Count        |                | RW         |
| C4          | Channel 1 Base & Current Address      |                | RW         |
| C6          | Channel 1 Base & Current Count        |                | RW         |
| C8          | Channel 2 Base & Current Address      |                | RW         |
| CA          | Channel 2 Base & Current Count        |                | RW         |
| CC          | Channel 3 Base & Current Address      |                | RW         |
| CE          | Channel 3 Base & Current Count        |                | RW         |
| D0          | Status / Command                      |                | RW         |
| D2          | Write Request                         |                | WO         |
| D4          | Write Single Mask                     |                | WO         |
| D6          | Write Mode                            |                | WO         |
| D8          | Clear Byte Pointer FF                 |                | WO         |
| DA          | Master Clear                          |                | WO         |
| DC          | Clear Mask                            |                | WO         |
| DE          | Read / Write Mask                     |                | RW         |

**Super-I/O Configuration Registers (I/O Space)**

| Port | Super-I/O Configuration Registers  | Default | Acc |
|------|------------------------------------|---------|-----|
| 3F0  | Super-I/O Config Index (Rx85[1]=1) | 00      | RW  |
| 3F1  | Super-I/O Config Data (Rx85[1]=1)  | 00      | RW  |

**Super-I/O Config Registers (Indexed via Port 3F0/1)**

| Offset | Super-I/O Control                     | Default | Acc |
|--------|---------------------------------------|---------|-----|
| 00-DF  | -reserved-                            | 00      | RO  |
| E0     | Super-I/O Device ID                   | 3C      | RW  |
| E1     | Super-I/O Device Revision             | 00      | RW  |
| E2     | Function Select                       | 00      | RW  |
| E3     | Floppy Ctrlr Base Addr (def = 3F0-7)  | FC      | RW  |
| E4-E5  | -reserved-                            | 00      | RO  |
| E6     | Parallel Port Base Addr (def = 378-F) | DE      | RW  |
| E7     | Serial Port 1 Base Addr (def = 3F8-F) | FE      | RW  |
| E8     | Serial Port 2 Base Addr (def = 2F8-F) | BE      | RW  |
| E9-ED  | -reserved-                            | 00      | RO  |
| EE     | Serial Port Configuration             | 00      | RW  |
| EF     | Power Down Control                    | 00      | RW  |
| F0     | Parallel Port Control                 | 00      | RW  |
| F1     | Serial Port Control                   | 00      | RW  |
| F2     | Test Mode (Do Not Program)            | 00      | RW  |
| F3     | -reserved-                            | 00      | RO  |
| F4     | Test Mode (Do Not Program) 2          | 00      | RW  |
| F5     | -reserved-                            | 00      | RO  |
| F6     | Floppy Controller Configuration       | 00      | RW  |
| F7     | -reserved-                            | 00      | RO  |
| F8     | Floppy Controller Drive Select        | 00      | RW  |
| F9-FB  | -reserved-                            | 00      | RO  |
| FC     | General Purpose I/O                   | 00      | RW  |
| FD-FF  | -reserved-                            | 00      | RO  |

**Super-I/O I/O Ports**

| Offset | Floppy Disk Controller (3F0-3F7) | Default | Acc |
|--------|----------------------------------|---------|-----|
| 00-01  | -reserved-                       | 00      | --  |
| 02     | FDC Command                      | --      | RW  |
| 03     | -reserved-                       | 00      | --  |
| 04     | FDC Main Status                  | --      | RO  |
| 04     | FDC Data Rate Select             | 00      | WO  |
| 05     | FDC Data                         | --      | RW  |
| 06     | -reserved-                       | 00      | --  |
| 07     | Diskchange Status                | --      | RO  |
| 07     | FDC Configuration Control        | 00      | WO  |

| Offset | Parallel Port (378-37F typical) | Default | Acc |
|--------|---------------------------------|---------|-----|
| 00     | Parallel Port Data              | --      | RW  |
| 01     | Parallel Port Status            | --      | RO  |
| 02     | Parallel Port Control           | E0      | RW  |
| 03     | EPP Address                     |         | RW  |
| 04     | EPP Data Port 0                 |         | RW  |
| 05     | EPP Data Port 1                 |         | RW  |
| 06     | EPP Data Port 2                 |         | RW  |
| 07     | EPP Data Port 3                 |         | RW  |
| 400h   | ECP Data / Configuration A      |         | RW  |
| 401h   | ECP Configuration B             |         | RW  |
| 402h   | ECP Extended Control            |         | RW  |

| Offset | Serial Port 1 (COM1=3F8, 3=3E8)     | Default | Acc |
|--------|-------------------------------------|---------|-----|
| 0      | Transmit (Wr) / Receive (Rd) Buffer |         | RW  |
| 1      | Interrupt Enable                    |         | RW  |
| 2      | FIFO Control                        |         | WO  |
| 2      | Interrupt Status                    |         | RO  |
| 3      | UART Control                        |         | RW  |
| 4      | Handshake Control                   |         | RW  |
| 5      | UART Status                         |         | RW  |
| 6      | Handshake Status                    |         | RW  |
| 7      | Scratchpad                          |         | RW  |
| 9-8    | Baud Rate Generator Divisor         |         | RW  |
| A-F    | -undefined-                         |         | --  |

| Offset | Serial Port 2 (COM2=2F8, 4=2E8)     | Default | Acc |
|--------|-------------------------------------|---------|-----|
| 0      | Transmit (Wr) / Receive (Rd) Buffer |         | RW  |
| 1      | Interrupt Enable                    |         | RW  |
| 2      | FIFO Control                        |         | WO  |
| 2      | Interrupt Status                    |         | RO  |
| 3      | UART Control                        |         | RW  |
| 4      | Handshake Control                   |         | RW  |
| 5      | UART Status                         |         | RW  |
| 6      | Handshake Status                    |         | RW  |
| 7      | Scratchpad                          |         | RW  |
| 9-8    | Baud Rate Generator Divisor         |         | RW  |
| A-F    | -undefined-                         |         | --  |

**PCI Function 0 Registers – PCI-to-ISA Bridge**
**Configuration Space PCI-to-ISA Bridge Header Registers**

| Offset | PCI Configuration Space Header       | Default     | Acc       |
|--------|--------------------------------------|-------------|-----------|
| 1-0    | Vendor ID                            | <b>1106</b> | RO        |
| 3-2    | Device ID                            | <b>8231</b> | RO        |
| 5-4    | Command                              | <b>0087</b> | <b>RW</b> |
| 7-6    | Status                               | <b>0200</b> | <b>WC</b> |
| 8      | Revision ID                          | <b>nn</b>   | RO        |
| 9      | Programming Interface                | 00          | RO        |
| A      | Sub Class Code                       | <b>01</b>   | RO        |
| B      | Base Class Code                      | <b>06</b>   | RO        |
| C      | -reserved- (cache line size)         | 00          | —         |
| D      | -reserved- (latency timer)           | 00          | —         |
| E      | Header Type                          | <b>80</b>   | RO        |
| F      | Built In Self Test (BIST)            | 00          | RO        |
| 10-27  | -reserved- (base address registers)  | 00          | —         |
| 28-2B  | -reserved- (unassigned)              | 00          | —         |
| 2F-2C  | Subsystem ID Read                    | 00          | RO        |
| 30-33  | -reserved- (expansion ROM base addr) | 00          | —         |
| 34-3B  | -reserved- (unassigned)              | 00          | —         |
| 3C     | -reserved- (interrupt line)          | 00          | —         |
| 3D     | -reserved- (interrupt pin)           | 00          | —         |
| 3E     | -reserved- (min gnt)                 | 00          | —         |
| 3F     | -reserved- (max lat)                 | 00          | —         |

**Configuration Space PCI-to-ISA Bridge-Specific Registers**

| Offset | ISA Bus Control                   | Default     | Acc |
|--------|-----------------------------------|-------------|-----|
| 40     | ISA Bus Control                   | 00          | RW  |
| 41     | ISA Test Mode                     | 00          | RW  |
| 42     | ISA Clock Control                 | 00          | RW  |
| 43     | ROM Decode Control                | 00          | RW  |
| 44     | Keyboard Controller Control       | 00          | RW  |
| 45     | Type F DMA Control                | 00          | RW  |
| 46     | Miscellaneous Control 1           | 00          | RW  |
| 47     | Miscellaneous Control 2           | 00          | RW  |
| 48     | Miscellaneous Control 3           | <b>01</b>   | RW  |
| 49     | -reserved-                        | 00          | —   |
| 4A     | IDE Interrupt Routing             | <b>04</b>   | RW  |
| 4B     | -reserved-                        | 00          | —   |
| 4C     | DMA / Master Mem Access Control 1 | 00          | RW  |
| 4D     | DMA / Master Mem Access Control 2 | 00          | RW  |
| 4F-4E  | DMA / Master Mem Access Control 3 | <b>0300</b> | RW  |

| Offset | Plug and Play Control           | Default    | Acc |
|--------|---------------------------------|------------|-----|
| 50     | PnP DMA Request Control         | <b>2D</b>  | RW  |
| 51     | PnP Routing for LPT / FDC IRQ   | 00         | RW  |
| 52     | PnP Routing for COM2 / COM1 IRQ | 00         | RW  |
| 53     | -reserved-                      | 00         | —   |
| 54     | PCI IRQ Edge / Level Select     | 00         | RW  |
| 55     | PnP Routing for PCI INTA        | 00         | RW  |
| 56     | PnP Routing for PCI INTB-C      | 00         | RW  |
| 57     | PnP Routing for PCI INTD        | 00         | RW  |
| 58     | -reserved-                      | 00         | —   |
| 59     | -reserved-                      | <b>04</b>  | —   |
| 5A     | KBC / RTC Control               | <b>x4†</b> | RW  |
| 5B     | Internal RTC Test Mode          | 00         | RW  |
| 5C     | DMA Control                     | 00         | RW  |
| 5D-5E  | -reserved-                      | 00         | —   |
| 5F     | -reserved- (do not program)     | <b>04</b>  | RW  |

† Bit 7-4 power-up default depends on external strapping

| Offset | Distributed DMA                 | Default | Acc |
|--------|---------------------------------|---------|-----|
| 61-60  | Channel 0 Base Address / Enable | 0000    | RW  |
| 63-62  | Channel 1 Base Address / Enable | 0000    | RW  |
| 65-64  | Channel 2 Base Address / Enable | 0000    | RW  |
| 67-66  | Channel 3 Base Address / Enable | 0000    | RW  |
| 69-68  | Serial IRQ Control              | 0000    | RW  |
| 6B-6A  | Channel 5 Base Address / Enable | 0000    | RW  |
| 6D-6C  | Channel 6 Base Address / Enable | 0000    | RW  |
| 6F-6E  | Channel 7 Base Address / Enable | 0000    | RW  |

| Offset | Miscellaneous                     | Default   | Acc |
|--------|-----------------------------------|-----------|-----|
| 70     | Subsystem ID Write                | 00        | WO  |
| 71-73  | -reserved-                        | 00        | —   |
| 74     | GPIO Control 1                    | 00        | RW  |
| 75     | GPIO Control 2                    | 00        | RW  |
| 76     | GPIO Control 3                    | 00        | RW  |
| 77     | GPIO Control 4                    | 00        | RW  |
| 79-78  | PCS0# I/O Port Address            | 0000 0000 | RW  |
| 7B-7A  | PCS1# I/O Port Address            | 0000 0000 | RW  |
| 7D-7C  | PCI DMA Channel Enable            | 0000      | RW  |
| 7F-7E  | 32-Bit DMA Control                | 0000      | RW  |
| 80     | Programmable Chip Select Mask     | 00        | RW  |
| 81     | ISA Positive Decoding Control 1   | 00        | RW  |
| 82     | ISA Positive Decoding Control 2   | 00        | RW  |
| 83     | ISA Positive Decoding Control 3   | 00        | RW  |
| 84     | ISA Positive Decoding Control 4   | 00        | RW  |
| 85     | Extended Function Enable          | 00        | RW  |
| 86-87  | PnP IRQ/DRQ Test (do not program) | 00        | RW  |
| 88     | PLL Test                          | 00        | RW  |
| 89     | PLL Control                       | 00        | RW  |
| 8A     | PCS2# I/O Port Address Mask       | 00        | RW  |
| 8B     | PCS Control                       | 00        | RW  |
| 8D-8C  | PCS2# I/O Port Address            | 0000      | RW  |
| 8F-8E  | PCS3# I/O Port Address            | 0000      | RW  |
| 90-FF  | -reserved-                        | 00        | —   |

**PCI Function 1 Registers – IDE Controller**
**Configuration Space IDE Header Registers**

| Offset | PCI Configuration Space Header      | Default         | Acc       |
|--------|-------------------------------------|-----------------|-----------|
| 1-0    | Vendor ID                           | <b>1106</b>     | RO        |
| 3-2    | Device ID                           | <b>0571</b>     | RO        |
| 5-4    | Command                             | <b>0080</b>     | RO        |
| 7-6    | Status                              | <b>0280</b>     | <b>RW</b> |
| 8      | Revision ID                         | <b>nn</b>       | RO        |
| 9      | Programming Interface               | <b>85</b>       | <b>RW</b> |
| A      | Sub Class Code                      | <b>01</b>       | RO        |
| B      | Base Class Code                     | <b>01</b>       | RO        |
| C      | -reserved- (cache line size)        | 00              | —         |
| D      | Latency Timer                       | 00              | <b>RW</b> |
| E      | Header Type                         | 00              | RO        |
| F      | Built In Self Test (BIST)           | 00              | RO        |
| 13-10  | Base Address – Pri Data / Command   | <b>000001F0</b> | RO        |
| 17-14  | Base Address – Pri Control / Status | <b>000003F4</b> | RO        |
| 1B-18  | Base Address – Sec Data / Command   | <b>00000170</b> | RO        |
| 1F-1C  | Base Address – Sec Control / Status | <b>00000374</b> | RO        |
| 23-20  | Base Address – Bus Master Control   | <b>0000CC01</b> | <b>RW</b> |
| 24-2F  | -reserved- (unassigned)             | 00              | —         |
| 30-33  | -reserved- (expan ROM base addr)    | 00              | —         |
| 34     | Capability Pointer                  | <b>C0</b>       | RO        |
| 35-3B  | -reserved- (unassigned)             | 00              | —         |
| 3C     | Interrupt Line                      | <b>0E</b>       | <b>RW</b> |
| 3D     | Interrupt Pin                       | 00              | RO        |
| 3E     | Minimum Grant                       | 00              | RO        |
| 3F     | Maximum Latency                     | 00              | RO        |

**Configuration Space IDE-Specific Registers**

| Offset | Configuration Space IDE Registers  | Default         | Acc       |
|--------|------------------------------------|-----------------|-----------|
| 40     | IDE Chip Enable                    | <b>08</b>       | RW        |
| 41     | IDE Configuration                  | <b>02</b>       | RW        |
| 42     | -reserved- (do not program)        | <b>09</b>       | <b>RW</b> |
| 43     | IDE FIFO Configuration             | <b>3A</b>       | RW        |
| 44     | IDE Miscellaneous Control 1        | <b>68</b>       | RW        |
| 45     | IDE Miscellaneous Control 2        | <b>03</b>       | RW        |
| 46     | IDE Miscellaneous Control 3        | <b>C0</b>       | RW        |
| 4B-48  | IDE Drive Timing Control           | <b>A8A8A8A8</b> | RW        |
| 4C     | IDE Address Setup Time             | <b>FF</b>       | RW        |
| 4D     | -reserved- (do not program)        | 00              | <b>RW</b> |
| 4E     | Sec Non-1F0 IDE Port Access Timing | <b>FF</b>       | RW        |
| 4F     | Pri Non-1F0 IDE Port Access Timing | <b>FF</b>       | RW        |

**Configuration Space IDE-Specific Registers (continued)**

| Offset | Configuration Space IDE Registers  | Default         | Acc       |
|--------|------------------------------------|-----------------|-----------|
| 53-50  | UltraDMA Extended Timing Control   | <b>03030303</b> | RW        |
| 54     | UltraDMA FIFO Control              | <b>06</b>       | RW        |
| 55-5F  | -reserved-                         | 00              | —         |
| 61-60  | IDE Primary Sector Size            | <b>0200</b>     | RW        |
| 62-67  | -reserved-                         | 00              | —         |
| 69-68  | IDE Secondary Sector Size          | <b>0200</b>     | RW        |
| 69-6F  | -reserved-                         | 00              | —         |
| 70     | IDE Primary Status                 | 00              | RW        |
| 71     | IDE Primary Interrupt Control      | 00              | RW        |
| 72-77  | -reserved-                         | 00              | —         |
| 78     | IDE Secondary Status               | 00              | RW        |
| 79     | IDE Secondary Interrupt Control    | 00              | RW        |
| 7A-7F  | -reserved-                         | 00              | —         |
| 83-80  | IDE Primary S/G Descriptor Address | 0000 0000       | RW        |
| 84-87  | -reserved-                         | 00              | —         |
| 8B-88  | IDE Secondary S/G Descriptor Addr  | 0000 0000       | RW        |
| 8C-BF  | -reserved-                         | 00              | —         |
| C3-C0  | PCI PM Block 1                     | <b>0201</b>     | <b>RO</b> |
| C7-C4  | PCI PM Block 2                     | 0000            | RW        |
| C8-FF  | -reserved-                         | 00              | —         |

**I/O Registers – IDE Controller (SFF 8038 v1.0 Compliant)**

| Offset | IDE I/O Registers                | Default | Acc       |
|--------|----------------------------------|---------|-----------|
| 0      | Primary Channel Command          | 00      | RW        |
| 1      | -reserved-                       | 00      | —         |
| 2      | Primary Channel Status           | 00      | <b>WC</b> |
| 3      | -reserved-                       | 00      | —         |
| 4-7    | Primary Channel PRD Table Addr   | 00      | RW        |
| 8      | Secondary Channel Command        | 00      | RW        |
| 9      | -reserved-                       | 00      | —         |
| A      | Secondary Channel Status         | 00      | <b>WC</b> |
| B      | -reserved-                       | 00      | —         |
| C-F    | Secondary Channel PRD Table Addr | 00      | RW        |



**PCI Function 2 Registers – USB Controller Ports 0-1**
**Configuration Space USB Header Registers**

| Offset | PCI Configuration Space Header | Default         | Acc       |
|--------|--------------------------------|-----------------|-----------|
| 1-0    | Vendor ID                      | <b>1106</b>     | RO        |
| 3-2    | Device ID                      | <b>3038</b>     | RO        |
| 5-4    | Command                        | 0000            | <b>RW</b> |
| 7-6    | Status                         | <b>0200</b>     | <b>WC</b> |
| 8      | Revision ID                    | <b>nn</b>       | RO        |
| 9      | Programming Interface          | 00              | RO        |
| A      | Sub Class Code                 | <b>03</b>       | RO        |
| B      | Base Class Code                | <b>0C</b>       | RO        |
| C      | Cache Line Size                | 00              | RO        |
| D      | Latency Timer                  | <b>16</b>       | <b>RW</b> |
| E      | Header Type                    | 00              | RO        |
| F      | BIST                           | 00              | RO        |
| 10-1F  | -reserved-                     | 00              | —         |
| 23-20  | USB I/O Register Base Address  | <b>00000301</b> | <b>RW</b> |
| 24-3B  | -reserved-                     | 00              | —         |
| 3C     | Interrupt Line                 | 00              | <b>RW</b> |
| 3D     | Interrupt Pin                  | <b>04</b>       | <b>RO</b> |
| 3E-3F  | -reserved-                     | 00              | —         |

**Configuration Space USB-Specific Registers**

| Offset | USB Control                       | Default          | Acc       |
|--------|-----------------------------------|------------------|-----------|
| 40     | USB Miscellaneous Control 1       | 00               | <b>RW</b> |
| 41     | USB Miscellaneous Control 2       | <b>10</b>        | <b>RW</b> |
| 42     | USB FIFO Control                  | 00               | <b>RW</b> |
| 43     | -reserved-                        | 00               | RO        |
| 44-45  | -reserved- (test, do not program) |                  | <b>RW</b> |
| 46-47  | -reserved- (test)                 |                  | RO        |
| 48-5F  | -reserved-                        | 00               | —         |
| 60     | USB Serial Bus Release Number     | <b>10</b>        | RO        |
| 61-7F  | -reserved-                        | 00               | —         |
| 83-80  | PM Capability                     | <b>0002 0001</b> | RO        |
| 84     | PM Capability Status              | 00               | <b>RW</b> |
| 85-BF  | -reserved-                        | 00               | —         |
| C1-C0  | USB Legacy Support                | <b>2000</b>      | <b>RW</b> |
| C2-FF  | -reserved-                        | 00               | —         |

**I/O Registers – USB Controller**

| Offset | USB I/O Registers       | Default     | Acc       |
|--------|-------------------------|-------------|-----------|
| 1-0    | USB Command             | 0000        | RW        |
| 3-2    | USB Status              | 0000        | <b>WC</b> |
| 5-4    | USB Interrupt Enable    | 0000        | RW        |
| 7-6    | Frame Number            | 0000        | RW        |
| B-8    | Frame List Base Address | 00000000    | RW        |
| C      | Start Of Frame Modify   | <b>40</b>   | RW        |
| 11-10  | Port 0 Status / Control | <b>0080</b> | <b>WC</b> |
| 13-12  | Port 1 Status / Control | <b>0080</b> | <b>WC</b> |
| 14-1F  | -reserved-              | 00          | —         |

**PCI Function 3 Registers – USB Controller Ports 2-3**
**Configuration Space USB Header Registers**

| Offset | PCI Configuration Space Header | Default         | Acc       |
|--------|--------------------------------|-----------------|-----------|
| 1-0    | Vendor ID                      | <b>1106</b>     | RO        |
| 3-2    | Device ID                      | <b>3038</b>     | RO        |
| 5-4    | Command                        | 0000            | <b>RW</b> |
| 7-6    | Status                         | <b>0200</b>     | <b>WC</b> |
| 8      | Revision ID                    | <b>nn</b>       | RO        |
| 9      | Programming Interface          | 00              | RO        |
| A      | Sub Class Code                 | <b>03</b>       | RO        |
| B      | Base Class Code                | <b>0C</b>       | RO        |
| C      | Cache Line Size                | 00              | RO        |
| D      | Latency Timer                  | <b>16</b>       | <b>RW</b> |
| E      | Header Type                    | 00              | RO        |
| F      | BIST                           | 00              | RO        |
| 10-1F  | -reserved-                     | 00              | —         |
| 23-20  | USB I/O Register Base Address  | <b>00000301</b> | <b>RW</b> |
| 24-3B  | -reserved-                     | 00              | —         |
| 3C     | Interrupt Line                 | 00              | <b>RW</b> |
| 3D     | Interrupt Pin                  | <b>04</b>       | <b>RO</b> |
| 3E-3F  | -reserved-                     | 00              | —         |

**Configuration Space USB-Specific Registers**

| Offset | USB Control                            | Default          | Acc       |
|--------|----------------------------------------|------------------|-----------|
| 40     | USB Miscellaneous Control 1            | 00               | <b>RW</b> |
| 41     | USB Miscellaneous Control 2            | <b>10</b>        | <b>RW</b> |
| 42     | USB FIFO Control                       | 00               | <b>RW</b> |
| 43     | -reserved-                             | 00               | RO        |
| 44-45  | -reserved- (test only, do not program) |                  | <b>RW</b> |
| 46-47  | -reserved- (test)                      |                  | RO        |
| 48-5F  | -reserved-                             | 00               | —         |
| 60     | USB Serial Bus Release Number          | <b>10</b>        | RO        |
| 61-7F  | -reserved-                             | 00               | —         |
| 83-80  | PM Capability                          | <b>0002 0001</b> | RO        |
| 84     | PM Capability Status                   | 00               | <b>RW</b> |
| 85-BF  | -reserved-                             | 00               | —         |
| C1-C0  | USB Legacy Support                     | <b>2000</b>      | <b>RW</b> |
| C2-FF  | -reserved-                             | 00               | —         |

**I/O Registers - USB Controller**

| Offset | USB I/O Registers       | Default     | Acc       |
|--------|-------------------------|-------------|-----------|
| 1-0    | USB Command             | 0000        | RW        |
| 3-2    | USB Status              | 0000        | <b>WC</b> |
| 5-4    | USB Interrupt Enable    | 0000        | RW        |
| 7-6    | Frame Number            | 0000        | RW        |
| B-8    | Frame List Base Address | 00000000    | RW        |
| C      | Start Of Frame Modify   | <b>40</b>   | RW        |
| 11-10  | Port 2 Status / Control | <b>0080</b> | <b>WC</b> |
| 13-12  | Port 3 Status / Control | <b>0080</b> | <b>WC</b> |
| 14-1F  | -reserved-              | 00          | —         |



## PCI Function 4 Registers - Power Management

### Configuration Space Power Management Header Registers

| Offset | PCI Configuration Space Header | Default     | Acc       |
|--------|--------------------------------|-------------|-----------|
| 1-0    | Vendor ID                      | <b>1106</b> | RO        |
| 3-2    | Device ID                      | <b>3068</b> | RO        |
| 5-4    | Command                        | 0000        | RO        |
| 7-6    | Status                         | <b>0280</b> | <b>WC</b> |
| 8      | Revision ID                    | <b>nn</b>   | RO        |
| 9      | Programming Interface          | 00†         | RO        |
| A      | Sub Class Code                 | 00†         | RO        |
| B      | Base Class Code                | 00†         | RO        |
| C      | Cache Line Size                | 00          | RO        |
| D      | Latency Timer                  | 00          | RO        |
| E      | Header Type                    | 00          | RO        |
| F      | BIST                           | 00          | RO        |
| 10-3F  | -reserved-                     | 00          | —         |

† The default values for these registers may be changed by writing to offsets 61-63h (see below).

### Configuration Space Power Management Registers

| Offset | Power Management                      | Default          | Acc       |
|--------|---------------------------------------|------------------|-----------|
| 40     | General Configuration 0               | 00               | RW        |
| 41     | General Configuration 1               | 00               | RW        |
| 42     | ACPI Interrupt Select                 | 00               | RW        |
| 43     | Internal Timer Read Test              | —                | <b>RO</b> |
| 45-44  | Primary Interrupt Channel             | 0000             | RW        |
| 47-46  | Secondary Interrupt Channel           | 0000             | RW        |
| 4B-48  | Power Mgmt I/O Base (256 Bytes)       | <b>0000 0001</b> | RW        |
| 4C     | Host Bus Power Management Control     | 00               | RW        |
| 4D     | Throttle / Clock Stop Control         | 00               | RW        |
| 4E-4F  | -reserved-                            | 00               | —         |
| 53-50  | GP Timer Control                      | 0000 0000        | RW        |
| 54     | Power Well Control                    | 00               | RW        |
| 55     | USB Wakeup Control                    | 00               | RW        |
| 56-57  | -reserved-                            | 00               | —         |
| 58     | GP2 / GP3 Timer Control               | 00               | RW        |
| 59     | GP2 Timer                             | 00               | RW        |
| 5A     | GP3 Timer                             | 00               | RW        |
| 5B-60  | -reserved-                            | 00               | —         |
| 61     | Write value for Offset 9 (Prog Intfc) | 00               | <b>WO</b> |
| 62     | Write value for Offset A (Sub Class)  | 00               | <b>WO</b> |
| 63     | Write value for Offset B (Base Class) | 00               | <b>WO</b> |
| 64-7F  | -reserved-                            | 00               | —         |

### Configuration Space Hardware Monitor Registers

| Offset | System Management Bus            | Default     | Acc |
|--------|----------------------------------|-------------|-----|
| 71-70  | Hardware Mon IO Base (128 Bytes) | <b>0001</b> | RW  |
| 72-73  | -reserved-                       | 00          | —   |
| 74     | Hardware Monitor Control         | 00          | RW  |
| 75-8F  | -reserved-                       | 00          | —   |

### Configuration Space SMBus Registers

| Offset | System Management Bus             | Default          | Acc       |
|--------|-----------------------------------|------------------|-----------|
| 93-90  | SMBus I/O Base (16 Bytes)         | <b>0000 0001</b> | RW        |
| 94-D1  | -reserved-                        | 00               | —         |
| D2     | SMBus Host Configuration          | 00               | RW        |
| D3     | SMBus Host Slave Command          | 00               | RW        |
| D4     | SMBus Slave Address Shadow Port 1 | 00               | RW        |
| D5     | SMBus Slave Address Shadow Port 2 | 00               | RW        |
| D6     | SMBus Revision ID                 | <b>nn</b>        | <b>RO</b> |
| D7-FF  | -reserved-                        | 00               | —         |

**I/O Space Power Management- Registers**

| Offset | Basic Control / Status Registers | Default   | Acc       |
|--------|----------------------------------|-----------|-----------|
| 1-0    | Power Management Status          | 0000      | <b>WC</b> |
| 3-2    | Power Management Enable          | 0000      | RW        |
| 5-4    | Power Management Control         | 0000      | RW        |
| 6-7    | -reserved-                       | 00        | —         |
| B-8    | Power Management Timer           | 0000 0000 | RW        |
| C-F    | -reserved-                       | 00        | —         |

| Offset | Processor Registers           | Default   | Acc       |
|--------|-------------------------------|-----------|-----------|
| 13-10  | Processor and PCI Bus Control | 0000 0000 | RW        |
| 14     | Processor LVL2                | 00        | <b>RO</b> |
| 15     | Processor LVL3                | 00        | <b>RO</b> |
| 16-1F  | -reserved-                    | 00        | —         |

| Offset | General Purpose Registers  | Default | Acc       |
|--------|----------------------------|---------|-----------|
| 21-20  | General Purpose Status     | 0000    | <b>WC</b> |
| 23-22  | General Purpose SCI Enable | 0000    | RW        |
| 25-24  | General Purpose SMI Enable | 0000    | RW        |
| 26-27  | -reserved-                 | 00      | —         |

| Offset | Generic Registers              | Default     | Acc       |
|--------|--------------------------------|-------------|-----------|
| 29-28  | Global Status                  | 0000        | <b>WC</b> |
| 2B-2A  | Global Enable                  | 0000        | RW        |
| 2D-2C  | Global Control                 | <b>0010</b> | RW        |
| 2E     | -reserved-                     | 00          | —         |
| 2F     | SMI Command                    | 00          | RW        |
| 33-30  | Primary Activity Detect Status | 0000 0000   | <b>WC</b> |
| 37-34  | Primary Activity Detect Enable | 0000 0000   | RW        |
| 3B-38  | GP Timer Reload Enable         | 0000 0000   | RW        |
| 3C-3F  | -reserved-                     | 00          | —         |

| Offset | General Purpose I/O Registers  | Default          | Acc       |
|--------|--------------------------------|------------------|-----------|
| 40     | Extended I/O Trap Status       | 00               | <b>WC</b> |
| 41     | -reserved-                     | 00               | —         |
| 42     | Extended I/O Trap Enable       | 00               | RW        |
| 43     | -reserved-                     | 00               | —         |
| 44     | External SMI / GPI Input Value | <b>input</b>     | <b>RO</b> |
| 45     | SMI / IRQ / Resume Status      | 00               | <b>RO</b> |
| 46-47  | -reserved-                     | 00               | —         |
| 4B-48  | GPI Port Input Value           | <b>input</b>     | <b>RO</b> |
| 4F-4C  | GPO Port Output Value          | <b>03FF FFFF</b> | RW        |
| 50-FF  | -reserved-                     | 00               | —         |

**I/O Space System Management Bus Registers**

| Offset | System Management Bus | Default | Acc       |
|--------|-----------------------|---------|-----------|
| 0      | SMBus Host Status     | 00      | <b>WC</b> |
| 1      | SMBus Slave Status    | 00      | RW        |
| 2      | SMBus Host Control    | 00      | RW        |
| 3      | SMBus Host Command    | 00      | RW        |
| 4      | SMBus Host Address    | 00      | RW        |
| 5      | SMBus Host Data 0     | 00      | RW        |
| 6      | SMBus Host Data 1     | 00      | RW        |
| 7      | SMBus Block Data      | 00      | RW        |
| 8      | SMBus Slave Control   | 00      | RW        |
| 9      | SMBus Shadow Command  | 00      | <b>RO</b> |
| A-B    | SMBus Slave Event     | 0000    | RW        |
| C-D    | SMBus Slave Data      | 0000    | <b>RO</b> |
| E-F    | -reserved-            | 00      | —         |

**I/O Space Hardware Monitor Registers**

| Offset | Hardware Monitor                   | Default | Acc |
|--------|------------------------------------|---------|-----|
| 00-3F  | Value RAM                          |         |     |
| 00-12  | -reserved-                         | 00      | —   |
| 13     | Analog Data 15-8                   | 00      | RW  |
| 14     | Analog Data 7-0                    | 00      | RW  |
| 15     | Digital Data 7-0                   | 00      | RW  |
| 16     | Channel Counter                    | 00      | RW  |
| 17     | Data Valid & Channel Indicators    | 00      | RW  |
| 18-1C  | -reserved-                         | 00      | —   |
| 1D     | TSENS3 Hot Hi Limit                | 00      | RW  |
| 1E     | TSENS3 Hot Hysteresis Lo Lim       | 00      | RW  |
| 1F     | TSENS3 (Int) Temp Reading          | 00      | RW  |
| 20     | TSENS1 (W13) Temp Reading          | 00      | RW  |
| 21     | TSENS2 (Y13) Temp Reading          | 00      | RW  |
| 22     | VSENS1 (U13) Voltage Reading       | 00      | RW  |
| 23     | VSENS2 (V13) Voltage Reading       | 00      | RW  |
| 24     | Internal Core VCC Voltage Reading  | 00      | RW  |
| 25     | VSENS3 (W14) Voltage Reading       | 00      | RW  |
| 26     | VSENS4 (Y14) Voltage Reading       | 00      | RW  |
| 27     | -reserved- (-12V Voltage Reading)  | 00      | —   |
| 28     | -reserved- (-5V Voltage Reading)   | 00      | —   |
| 29     | FAN1 (T12) Count Reading           | 00      | RW  |
| 2A     | FAN2 (U12) Count Reading           | 00      | RW  |
| 2B     | VSENS1 (CPU) Voltage High Limit    | 00      | RW  |
| 2C     | VSENS1 (CPU) Voltage Low Limit     | 00      | RW  |
| 2D     | VSENS2 (NB) Voltage High Limit     | 00      | RW  |
| 2E     | VSENS2 (NB) Voltage Low Limit      | 00      | RW  |
| 2F     | Internal Core VCC High Limit       | 00      | RW  |
| 30     | Internal Core VCC Low Limit        | 00      | RW  |
| 31     | VSENS3 (5V) Voltage High Limit     | 00      | RW  |
| 32     | VSENS3 (5V) Voltage Low Limit      | 00      | RW  |
| 33     | VSENS4 (12V) Voltage High Limit    | 00      | RW  |
| 34     | VSENS4 (12V) Voltage Low Limit     | 00      | RW  |
| 35     | -reserved- (-12V Sense High Limit) | 00      | —   |
| 36     | -reserved- (-12V Sense Low Limit)  | 00      | —   |
| 37     | -reserved- (-5V Sense High Limit)  | 00      | —   |
| 38     | -reserved- (-5V Sense Low Limit)   | 00      | —   |
| 39     | TSENS1 Hot High Limit              | 00      | RW  |
| 3A     | TSENS1 Hot Hysteresis Lo Lim       | 00      | RW  |
| 3B     | FAN1 Fan Count Limit               | 00      | RW  |
| 3C     | FAN2 Fan Count Limit               | 00      | RW  |
| 3D     | TSENS2 Hot High Limit              | 00      | RW  |
| 3E     | TSENS2 Hot Hysteresis Lo Lim       | 00      | RW  |
| 3F     | Stepping ID Number                 | 00      | RW  |

| Offset | Hardware Monitor (continued)        | Default   | Acc       |
|--------|-------------------------------------|-----------|-----------|
| 40     | Hardware Monitor Configuration      | <b>08</b> | RW        |
| 41     | Hardware Monitor Interrupt Status 1 | 00        | <b>RO</b> |
| 42     | Hardware Monitor Interrupt Status 2 | 00        | <b>RO</b> |
| 43     | Hardware Monitor Interrupt Mask 1   | 00        | RW        |
| 44     | Hardware Monitor Interrupt Mask 2   | 00        | RW        |
| 45-46  | -reserved-                          | 00        | —         |
| 47     | Hardware Monitor Fan Configuration  | <b>50</b> | RW        |
| 48     | -reserved-                          | 00        | —         |
| 49     | HW Mon Temp Value Lo-Order Bits     | 00        | RW        |
| 4A     | -reserved-                          | 00        | —         |
| 4B     | Temperature Interrupt Configuration | <b>15</b> | RW        |
| 4C-FF  | -reserved-                          | 00        | —         |

**PCI Function 5 & 6 Registers – AC97 / MC97 Codecs**
**Function 5 Configuration Space AC97 Header Registers**

| Offset | PCI Configuration Space Header      | Default          | Acc       |
|--------|-------------------------------------|------------------|-----------|
| 1-0    | Vendor ID                           | <b>1106</b>      | RO        |
| 3-2    | Device ID                           | <b>3058</b>      | RO        |
| 5-4    | Command                             | 0000             | <b>RW</b> |
| 7-6    | Status                              | <b>0210</b>      | <b>WC</b> |
| 8      | Revision ID                         | <b>40</b>        | RO        |
| 9      | Programming Interface               | 00               | RO        |
| A      | Sub Class Code                      | <b>01</b>        | RO        |
| B      | Base Class Code                     | <b>04</b>        | RO        |
| C      | Cache Line Size                     | 00               | RO        |
| D      | Latency Timer                       | 00               | <b>RW</b> |
| E      | Header Type                         | 00               | RO        |
| F      | BIST                                | 00               | RO        |
| 13-10  | Base Address 0 - SGD Control/Status | <b>0000 0001</b> | <b>RW</b> |
| 17-14  | Base Address 1 - FM NMI Status      | <b>0000 0001</b> | <b>RW</b> |
| 1B-18  | Base Address 2 - MIDI Port          | <b>0000 0331</b> | <b>RW</b> |
| 1F-1C  | Base Address 3 (reserved)           | 0000 0000        | —         |
| 23-20  | Base Address 4 (reserved)           | 0000 0000        | —         |
| 27-24  | Base Address 5 (reserved)           | 0000 0000        | —         |
| 28-29  | -reserved-                          | 00               | —         |
| 2F-2C  | Subsystem ID / SubVendor ID         | 0000 0000        | <b>RW</b> |
| 33-30  | Expansion ROM (reserved)            | 0000 0000        | —         |
| 34     | Capture Pointer                     | 00               | <b>RW</b> |
| 35-3B  | -reserved-                          | 00               | —         |
| 3C     | Interrupt Line                      | 00               | <b>RW</b> |
| 3D     | Interrupt Pin                       | <b>03</b>        | RO        |
| 3E     | Minimum Grant                       | 00               | RO        |
| 3F     | Maximum Latency                     | 00               | RO        |

**Configuration Space Audio Codec-Specific Registers**

| Offset | Audio Codec Link Control  | Default   | Acc       |
|--------|---------------------------|-----------|-----------|
| 40     | AC-Link Interface Status  | 00        | <b>RO</b> |
| 41     | AC-Link Interface Control | 00        | RW        |
| 42     | Function Enable           | 00        | RW        |
| 43     | Plug and Play Control     | <b>1C</b> | RW        |
| 44     | MC97 Interface Control    | 00        | <b>RO</b> |
| 45-47  | -reserved-                | 00        | —         |
| 48     | FM NMI Control            | 00        | RW        |
| 49     | -reserved-                | 00        | —         |
| 4B-4A  | Game Port Base Address    | 0000      | RW        |
| 4C-FF  | -reserved-                | 00        | —         |

**Function 6 Configuration Space MC97 Header Registers**

| Offset | PCI Configuration Space Header      | Default          | Acc       |
|--------|-------------------------------------|------------------|-----------|
| 1-0    | Vendor ID                           | <b>1106</b>      | RO        |
| 3-2    | Device ID                           | <b>3068</b>      | RO        |
| 5-4    | Command                             | 0000             | <b>RW</b> |
| 7-6    | Status                              | <b>0200</b>      | <b>WC</b> |
| 8      | Revision ID                         | <b>40</b>        | RO        |
| 9      | Programming Interface               | 00               | RO        |
| A      | Sub Class Code                      | <b>80</b>        | RO        |
| B      | Base Class Code                     | <b>07</b>        | RO        |
| C      | Cache Line Size                     | 00               | RO        |
| D      | Latency Timer                       | 00               | <b>RW</b> |
| E      | Header Type                         | 00               | RO        |
| F      | BIST                                | 00               | RO        |
| 13-10  | Base Address 0 - SGD Control/Status | <b>0000 0001</b> | <b>RW</b> |
| 17-14  | Base Address 1 - (reserved)         | 0000 0000        | <b>RW</b> |
| 1B-18  | Base Address 2 - (reserved)         | 0000 0000        | <b>RW</b> |
| 1F-1C  | Base Address 3 – Codec Reg Shadow   | <b>0000 0001</b> | —         |
| 23-20  | Base Address 4 (reserved)           | 0000 0000        | —         |
| 27-24  | Base Address 5 (reserved)           | 0000 0000        | —         |
| 28-29  | -reserved-                          | 00               | —         |
| 2F-2C  | Subsystem ID / SubVendor ID         | 0000 0000        | <b>RW</b> |
| 33-30  | Expansion ROM (reserved)            | 0000 0000        | —         |
| 34     | Capture Pointer                     | 00               | <b>RW</b> |
| 35-3B  | -reserved-                          | 00               | —         |
| 3C     | Interrupt Line                      | 00               | <b>RW</b> |
| 3D     | Interrupt Pin                       | <b>03</b>        | RO        |
| 3E     | Minimum Grant                       | 00               | RO        |
| 3F     | Maximum Latency                     | 00               | RO        |

**Configuration Space Modem Codec-Specific Registers**

| Offset | Modem Codec Link Control  | Default   | Acc       |
|--------|---------------------------|-----------|-----------|
| 40     | AC-Link Interface Status  | 00        | <b>RO</b> |
| 41     | AC-Link Interface Control | 00        | RW        |
| 42     | Function Enable           | 00        | <b>RO</b> |
| 43     | Plug and Play Control     | <b>1C</b> | <b>RO</b> |
| 44     | MC97 Interface Control    | 00        | RW        |
| 45-47  | -reserved-                | 00        | —         |
| 48     | FM NMI Control            | 00        | <b>RO</b> |
| 49     | -reserved-                | 00        | —         |
| 4B-4A  | Game Port Base Address    | 0000      | <b>RO</b> |
| 4C-FF  | -reserved-                | 00        | —         |

**Func 5 I/O Base 0 Regs – Audio Scatter-Gather DMA**

| Offset | SGD I/O Registers (DSXn: n=1-3)                                        | Default   | Acc       |
|--------|------------------------------------------------------------------------|-----------|-----------|
| n0     | SGD DXSn Read Channel Status                                           | 00        | <b>WC</b> |
| n1     | SGD DXSn Read Channel Control                                          | 00        | RW        |
| n2     | SGD DXSn Read Chan Left Volume                                         | 00        | RW        |
| n3     | SGD DXSn Read Chan Right Volume                                        | 00        | RW        |
| n7-n4  | SGD DXSn Read Ch Table Ptr Base<br>SGD DXSn Read Ch Current Address    | 0000 0000 | WR<br>RD  |
| nB-n8  | SGD DXSn Read Channel Format                                           | 0000 0000 | <b>RO</b> |
| nF-nC  | SGD DXSn Read Chan Index / Count                                       | 0000 0000 | <b>RO</b> |
| 40     | SGD 3D Channel Status                                                  | 00        | <b>WC</b> |
| 41     | SGD 3D Channel Control                                                 | 00        | RW        |
| 42     | SGD 3D Channel Format                                                  | 00        | RW        |
| 43     | SGD 3D Channel Scratch                                                 | 00        | RW        |
| 47-44  | SGD 3D Channel Table Ptr Base<br>SGD 3D Channel Current Address        | 0000 0000 | WR<br>RD  |
| 4B-48  | SGD 3D Channel Slot Select                                             | 0000 0000 | RW        |
| 4F-4C  | SGD 3D Channel Index / Count                                           | 0000 0000 | <b>RO</b> |
| 50     | SGD FM Channel Status                                                  | 00        | <b>WC</b> |
| 51     | SGD FM Channel Control                                                 | 00        | RW        |
| 52     | SGD FM Channel Type                                                    | 00        | RW        |
| 53     | -reserved-                                                             | 00        | —         |
| 57-54  | SGD FM Channel Table Pointer Base<br>SGD FM Channel Current Address    | 0000 0000 | WR<br>RD  |
| 58-5B  | -reserved-                                                             | 00        | —         |
| 5F-5C  | SGD FM Channel Current Count                                           | 0000 0000 | <b>RO</b> |
| 60     | SGD Write Channel 0 Status                                             | 00        | <b>WC</b> |
| 61     | SGD Write Channel 0 Control                                            | 00        | RW        |
| 62     | SGD Write Channel 0 Format                                             | 00        | RW        |
| 63     | -reserved-                                                             | 00        | —         |
| 67-64  | SGD Write Channel 0 Table Ptr Base<br>SGD Write Channel 0 Current Addr | 0000 0000 | WR<br>RD  |
| 68-6B  | -reserved-                                                             | 00        | —         |
| 6F-6C  | SGD Write Channel 0 Current Count                                      | 0000 0000 | <b>RO</b> |
| 70     | SGD Write Channel 1 Status                                             | 00        | <b>WC</b> |
| 71     | SGD Write Channel 1 Control                                            | 00        | RW        |
| 72     | SGD Write Channel 1 Format                                             | 00        | RW        |
| 73     | -reserved-                                                             | 00        | —         |
| 77-74  | SGD Write Channel 1 Table Ptr Base<br>SGD Write Channel 1 Current Addr | 0000 0000 | WR<br>RD  |
| 78-7B  | -reserved-                                                             | 00        | —         |
| 7F-7C  | SGD Write Channel 1 Current Count                                      | 0000 0000 | <b>RO</b> |

| Offset | AC97 Controller I/O Registers    | Default   | Acc       |
|--------|----------------------------------|-----------|-----------|
| 80-DF  | -reserved-                       | 00        | —         |
| E3-E0  | AC97 Controller Command / Status | 0000 0000 | RW        |
| E4-EF  | -reserved-                       | 00        | —         |
| F3-F0  | SGD Status Shadow                | 0000 0000 | <b>RO</b> |
| F4-FF  | -reserved-                       | 00        | —         |

The above registers are accessible through **function 5** only.

**Function 5 I/O Base 1 Registers – FM NMI Status**

| Offset | FM NMI Status Registers | Default | Acc       |
|--------|-------------------------|---------|-----------|
| 0      | FM NMI Status           | 00      | <b>RO</b> |
| 1      | FM NMI Data             | 00      | <b>RO</b> |
| 2      | FM NMI Index            | 00      | <b>RO</b> |
| 3      | Reserved                | 00      | —         |

The above registers are accessible through **function 5** only.

**Function 5 I/O Base 2 Registers – MIDI / Game Port**

| Offset | FM NMI Status Registers | Default | Acc |
|--------|-------------------------|---------|-----|
| 1-0    | MIDI Port Base          | 0330    | RW  |
| 3-2    | Game Port Base          | 0200    | RW  |

The above registers are accessible through **function 5** only.

**Func 6 I/O Base 0 Regs – Modem Scatter Gather DMA**

| Offset | MC97 SGD I/O Registers                                             | Default   | Acc       |
|--------|--------------------------------------------------------------------|-----------|-----------|
| 0      | SGD Modem Read Channel Status                                      | 00        | <b>WC</b> |
| 1      | SGD Modem Read Channel Control                                     | 00        | RW        |
| 2      | SGD Modem Read Channel Type                                        | 00        | RW        |
| 3      | -reserved-                                                         | 00        | —         |
| 7-4    | SGD Modem Read Ch Table Ptr Base<br>SGD Modem Read Ch Current Addr | 0000 0000 | WR<br>RD  |
| 8-B    | -reserved-                                                         | 00        | —         |
| F-C    | SGD Modem Read Ch Current Count                                    | 0000 0000 | <b>RO</b> |
| 10     | SGD Modem Write Channel Status                                     | 00        | <b>WC</b> |
| 11     | SGD Modem Write Channel Control                                    | 00        | RW        |
| 12     | SGD Modem Write Channel Type                                       | 00        | RW        |
| 13     | -reserved-                                                         | 00        | —         |
| 17-14  | SGD Modem Wr Ch Table Ptr Base<br>SGD Modem Wr Ch Current Address  | 0000 0000 | WR<br>RD  |
| 18-1B  | -reserved-                                                         | 00        | —         |
| 1F-1C  | SGD Modem Write Ch Current Count                                   | 0000 0000 | <b>RO</b> |

| Offset | Modem Codec I/O Registers         | Default   | Acc       |
|--------|-----------------------------------|-----------|-----------|
| 23-20  | Modem Codec Command / Status      | 0000 0000 | RW        |
| 24-2F  | -reserved-                        | 00        | —         |
| 33-30  | Codec GPI Interrupt Status / GPIO | 0000 0000 | <b>WC</b> |
| 37-34  | Codec GPI Interrupt Enable        | 0000 0000 | RW        |
| 38-FF  | Reserved                          | 00        | —         |

The above registers are accessible through **function 6** only.

**I/O Registers – SoundBlaster Pro**

| <b>Offset</b> | <b>SB Pro Registers (220 or 240h typ)</b>                       | <b>Default</b> | <b>Acc</b> |
|---------------|-----------------------------------------------------------------|----------------|------------|
| 0             | FM Left Channel Index / Status                                  |                | RW         |
| 1             | FM Left Channel Data                                            |                | <b>WO</b>  |
| 2             | FM Right Channel Index / Status                                 |                | RW         |
| 3             | FM Right Channel Data                                           |                | <b>WO</b>  |
| 4             | Mixer Index                                                     |                | <b>WO</b>  |
| 5             | Mixer Data                                                      |                | RW         |
| 6             | Sound Processor Reset                                           |                | <b>WO</b>  |
| 7             | -reserved-                                                      | 00             | --         |
| 8             | FM Index / Status (Both Channels)                               |                | RW         |
| 9             | FM Data (Both Channels)                                         |                | <b>WO</b>  |
| A             | Sound Processor Data                                            |                | <b>RO</b>  |
| B             | -reserved-                                                      | 00             | --         |
| C             | Sound Processor Command / Data<br>Sound Processor Buffer Status |                | WR<br>RD   |
| D             | -reserved-                                                      | 00             | --         |
| E             | Snd Processor Data Available Status                             |                | <b>RO</b>  |
| F             | -reserved-                                                      | 00             | --         |

| <b>Port</b> | <b>SB Pro Regs (same as offsets 8 &amp; 9)</b> | <b>Default</b> | <b>Acc</b> |
|-------------|------------------------------------------------|----------------|------------|
| 388h        | FM Index / Status                              |                | RW         |
| 389h        | FM Data                                        |                | <b>WO</b>  |

The above group of registers emulates the “FM”, “Mixer”, and “Sound Processor” functions of the SoundBlaster Pro.

**I/O Registers – Game Port**

| <b>Offset</b> | <b>Game Port (200-20F typical)</b> | <b>Default</b> | <b>Acc</b> |
|---------------|------------------------------------|----------------|------------|
| 0             | -reserved-                         | 00             | --         |
| 1             | Game Port Status                   |                | <b>RO</b>  |
| 1             | Start One-Shot                     |                | <b>WO</b>  |
| 2-F           | -reserved-                         | 00             | --         |

## **Register Descriptions**

### **Legacy I/O Ports**

This group of registers includes the DMA Controllers, Interrupt Controllers, and Timer/Counters as well as a number of miscellaneous ports originally implemented using discrete logic on original PC/AT motherboards. All of the registers listed are integrated on-chip. These registers are implemented in a precise manner for backwards compatibility with previous generations of PC hardware. These registers are listed for information purposes only. Detailed descriptions of the actions and programming of these registers are included in numerous industry publications (duplication of that information here is beyond the scope of this document). All of these registers reside in I/O space.

### **Port 61 - Misc Functions & Speaker Control..... RW**

- 7 Reserved** .....always reads 0
- 6 IOCHCK# Active** .....RO  
This bit is set when the ISA bus IOCHCK# signal is asserted. Once set, this bit may be cleared by setting bit-3 of this register. Bit-3 should be cleared to enable recording of the next IOCHCK#. IOCHCK# generates NMI to the CPU if NMI is enabled.
- 5 Timer/Counter 2 Output**.....RO  
This bit reflects the output of Timer/Counter 2 without any synchronization.
- 4 Refresh Detected**.....RO  
This bit toggles on every rising edge of the ISA bus REFRESH# signal.
- 3 IOCHCK# Disable**.....RW
  - 0 Enable IOCHCK# assertions ..... default
  - 1 Force IOCHCK# inactive and clear any "IOCHCK# Active" condition in bit-6
- 2 Reserved** .....RW, default=0
- 1 Speaker Enable** .....RW
  - 0 Disable..... default
  - 1 Enable Timer/Ctr 2 output to drive SPKR pin
- 0 Timer/Counter 2 Enable** .....RW
  - 0 Disable..... default
  - 1 Enable Timer/Counter 2

### **Port 92h - System Control..... RW**

- 7-6 Hard Disk Activity LED Status**
  - 0 Off ..... default
  - 1-3 On
- 5-4 Reserved** .....always reads 0
- 3 Power-On Password Bytes Inaccessible** ..default=0
- 2 Reserved** .....always reads 0
- 1 A20 Address Line Enable**
  - 0 A20 disabled / forced 0 (real mode) ..... default
  - 1 A20 address line enabled
- 0 High Speed Reset**
  - 0 Normal
  - 1 Briefly pulse system reset to switch from protected mode to real mode



### **Keyboard Controller Registers**

The keyboard controller handles the keyboard and mouse interfaces. Two ports are used: port 60 and port 64. Reads from port 64 return a status byte. Writes to port 64h are command codes (see command code list following the register descriptions). Input and output data is transferred via port 60.

A "Control" register is also available. It is accessible by writing commands 20h / 60h to the command port (port 64h); The control byte is written by first sending 60h to the command port, then sending the control byte value. The control register may be read by sending a command of 20h to port 64h, waiting for "Output Buffer Full" status = 1, then reading the control byte value from port 60h.

Traditional (non-integrated) keyboard controllers have an "Input Port" and an "Output Port" with specific pins dedicated to certain functions and other pins available for general purpose I/O. Specific commands are provided to set these pins high and low. All outputs are "open-collector" so to allow input on one of these pins, the output value for that pin would be set high (non-driving) and the desired input value read on the input port. These ports are defined as follows:

| <b>Bit</b> | <b>Input Port</b>                | <b>Lo Code</b> | <b>Hi Code</b> |
|------------|----------------------------------|----------------|----------------|
| 0          | P10 - Keyboard Data In           | B0             | B8             |
| 1          | P11 - Mouse Data In              | B1             | B9             |
| 2          | P12 - Turbo Pin (PS/2 mode only) | B2             | BA             |
| 3          | P13 - user-defined               | B3             | BB             |
| 4          | P14 - user-defined               | B6             | BE             |
| 5          | P15 - user-defined               | B7             | BF             |
| 6          | P16 - user-defined               | —              | —              |
| 7          | P17 - undefined                  | —              | —              |

| <b>Bit</b> | <b>Output Port</b>                  | <b>Lo Code</b> | <b>Hi Code</b> |
|------------|-------------------------------------|----------------|----------------|
| 0          | P20 - SYSRST (1=execute reset)      | —              | —              |
| 1          | P21 - GATEA20 (1=A20 enabled)       | —              | —              |
| 2          | P22 - Mouse Data Out                | B4             | BC             |
| 3          | P23 - Mouse Clock Out               | B5             | BD             |
| 4          | P24 - Keyboard OBF Interrupt (IRQ1) | —              | —              |
| 5          | P25 - Mouse OBF Interrupt (IRQ 12)  | —              | —              |
| 6          | P26 - Keyboard Clock Out            | —              | —              |
| 7          | P27 - Keyboard Data Out             | —              | —              |

| <b>Bit</b> | <b>Test Port</b>       | <b>Lo Code</b> | <b>Hi Code</b> |
|------------|------------------------|----------------|----------------|
| 0          | T0 - Keyboard Clock In | —              | —              |
| 1          | T1 - Mouse Clock In    | —              | —              |

Note: Command code C0h transfers input port data to the output buffer. Command code D0h copies output port values to the output buffer. Command code E0h transfers test input port data to the output buffer.

### **Port 60 - Keyboard Controller Input Buffer ..... WO**

Only write to port 60h if port 64h bit-1 = 0 (1=full).

### **Port 60 - Keyboard Controller Output Buffer .....RO**

Only read from port 60h if port 64h bit-0 = 1 (0=empty).

### **Port 64 - Keyboard / Mouse Status ..... RO**

- 7 Parity Error**
  - 0 No parity error (odd parity received)..... default
  - 1 Even parity occurred on last byte received from keyboard / mouse
- 6 General Receive / Transmit Timeout**
  - 0 No error ..... default
  - 1 Error
- 5 Mouse Output Buffer Full**
  - 0 Mouse output buffer empty..... default
  - 1 Mouse output buffer holds mouse data
- 4 Keylock Status**
  - 0 Locked
  - 1 Free
- 3 Command / Data**
  - 0 Last write was data write ..... default
  - 1 Last write was command write
- 2 System Flag**
  - 0 Power-On Default..... default
  - 1 Self Test Successful
- 1 Input Buffer Full**
  - 0 Input Buffer Empty..... default
  - 1 Input Buffer Full
- 0 Keyboard Output Buffer Full**
  - 0 Keyboard Output Buffer Empty..... default
  - 1 Keyboard Output Buffer Full

### **KBC Control Register .....(R/W via Commands 20h/60h)**

- 7 Reserved** .....always reads 0
- 6 PC Compatibility**
  - 0 Disable scan conversion
  - 1 Convert scan codes to PC format; convert 2-byte break sequences to 1-byte PC-compatible break codes ..... default
- 5 Mouse Disable**
  - 0 Enable Mouse Interface ..... default
  - 1 Disable Mouse Interface
- 4 Keyboard Disable**
  - 0 Enable Keyboard Interface ..... default
  - 1 Disable Keyboard Interface
- 3 Keyboard Lock Disable**
  - 0 Enable Keyboard Inhibit Function..... default
  - 1 Disable Keyboard Inhibit Function
- 2 System Flag** ..... default=0  
This bit may be read back as status register bit-2
- 1 Mouse Interrupt Enable**
  - 0 Disable mouse interrupts ..... default
  - 1 Generate interrupt on IRQ12 when mouse data comes in output bufer
- 0 Keyboard Interrupt Enable**
  - 0 Disable Keyboard Interrupts..... default
  - 1 Generate interrupt on IRQ1 when output buffer has been written.



**Port 64 - Keyboard / Mouse Command..... WO**

This port is used to send commands to the keyboard / mouse controller. The command codes recognized by the VT8231 are listed in the table below.

Note: The VT8231 Keyboard Controller is compatible with the VIA VT82C42 Industry-Standard Keyboard Controller except that due to its integrated nature, many of the input and output port pins are not available externally for use as general purpose I/O pins (even though P13-P16 are set on power-up as strapping options). In other words, many of the commands below are provided and “work”, but otherwise perform no useful function (e.g., commands that set P12-P17 high or low). Also note that setting P10-11, P22-23, P26-27, and T0-1 high or low directly serves no useful purpose, since these bits are used to implement the keyboard and mouse ports and are directly controlled by keyboard controller logic.

**Table 4. Keyboard Controller Command Codes**

| <b><u>Code</u></b> | <b><u>Keyboard Command Code Description</u></b>                                                                                                              | <b><u>Code</u></b> | <b><u>Keyboard Command Code Description</u></b>                                                                                                         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20h                | Read Control Byte (next byte is Control Byte)                                                                                                                | C0h                | Read input port (read P10-17 input data to the output buffer)                                                                                           |
| 21-3Fh             | Read SRAM Data (next byte is Data Byte)                                                                                                                      | C1h                | Poll input port low (read input data on P11-13 repeatably & put in bits 5-7 of status)                                                                  |
| 60h                | Write Control Byte (next byte is Control Byte)                                                                                                               | C2h                | Poll input port high (same except P15-17)                                                                                                               |
| 61-7Fh             | Write SRAM Data (next byte is Data Byte)                                                                                                                     | C8h                | Unblock P22-23 (use before D1 to change active mode)                                                                                                    |
| 9xh                | Write low nibble (bits 0-3) to P10-P13                                                                                                                       | C9h                | Reblock P22-23 (protection mechanism for D1)                                                                                                            |
| A1h                | Output Keyboard Controller Version #                                                                                                                         | CAh                | Read mode (output KBC mode info to port 60 output buffer (bit-0=0 if ISA, 1 if PS/2))                                                                   |
| A4h                | Test if Password is installed<br>(always returns F1h to indicate not installed)                                                                              | D0h                | Read Output Port (copy P10-17 output port values to port 60)                                                                                            |
| A7h                | Disable Mouse Interface                                                                                                                                      | D1h                | Write Output Port (data byte following is written to keyboard output port as if it came from keyboard)                                                  |
| A8h                | Enable Mouse Interface                                                                                                                                       | D2h                | Write Keyboard Output Buffer & clear status bit-5 (write following byte to keyboard)                                                                    |
| A9h                | Mouse Interface Test (puts test results in port 60h)<br>(value: 0=OK, 1=clk stuck low, 2=clk stuck high, 3=data stuck lo, 4=data stuck hi, FF=general error) | D3h                | Write Mouse Output Buffer & set status bit-5 (write following byte to mouse; put value in mouse input buffer so it appears to have come from the mouse) |
| AAh                | KBC self test (returns 55h if OK, FCh if not)                                                                                                                | D4h                | Write Mouse (write following byte to mouse)                                                                                                             |
| ABh                | Keyboard Interface Test (see A9h Mouse Test)                                                                                                                 | E0h                | Read test inputs (T0-1 read to bits 0-1 of resp byte)                                                                                                   |
| ADh                | Disable Keyboard Interface                                                                                                                                   | Exh                | Set P23-P21 per command bits 3-1                                                                                                                        |
| AEh                | Enable Keyboard Interface                                                                                                                                    | Fxh                | Pulse P23-P20 low for 6usec per command bits 3-0                                                                                                        |
| AFh                | Return Version #                                                                                                                                             |                    |                                                                                                                                                         |
| B0h                | Set P10 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B1h                | Set P11 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B2h                | Set P12 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B3h                | Set P13 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B4h                | Set P22 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B5h                | Set P23 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B6h                | Set P14 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B7h                | Set P15 low                                                                                                                                                  |                    |                                                                                                                                                         |
| B8h                | Set P10 high                                                                                                                                                 |                    |                                                                                                                                                         |
| B9h                | Set P11 high                                                                                                                                                 |                    |                                                                                                                                                         |
| BAh                | Set P12 high                                                                                                                                                 |                    |                                                                                                                                                         |
| BBh                | Set P13 high                                                                                                                                                 |                    |                                                                                                                                                         |
| BCh                | Set P22 high                                                                                                                                                 |                    |                                                                                                                                                         |
| BDh                | Set P23 high                                                                                                                                                 |                    |                                                                                                                                                         |
| BEh                | Set P14 high                                                                                                                                                 |                    |                                                                                                                                                         |
| BFh                | Set P15 high                                                                                                                                                 |                    |                                                                                                                                                         |

All other codes not listed are undefined.

## **DMA Controller I/O Registers**

### **Ports 00-0F - Master DMA Controller**

Channels 0-3 of the Master DMA Controller control System DMA Channels 0-3. There are 16 Master DMA Controller registers:

| <u>I/O Address Bits 15-0</u> | <u>Register Name</u>        |    |
|------------------------------|-----------------------------|----|
| 0000 0000 000x 0000          | Ch 0 Base / Current Address | RW |
| 0000 0000 000x 0001          | Ch 0 Base / Current Count   | RW |
| 0000 0000 000x 0010          | Ch 1 Base / Current Address | RW |
| 0000 0000 000x 0011          | Ch 1 Base / Current Count   | RW |
| 0000 0000 000x 0100          | Ch 2 Base / Current Address | RW |
| 0000 0000 000x 0101          | Ch 2 Base / Current Count   | RW |
| 0000 0000 000x 0110          | Ch 3 Base / Current Address | RW |
| 0000 0000 000x 0111          | Ch 3 Base / Current Count   | RW |
| 0000 0000 000x 1000          | Status / Command            | RW |
| 0000 0000 000x 1001          | Write Request               | WO |
| 0000 0000 000x 1010          | Write Single Mask           | WO |
| 0000 0000 000x 1011          | Write Mode                  | WO |
| 0000 0000 000x 1100          | Clear Byte Pointer F/F      | WO |
| 0000 0000 000x 1101          | Master Clear                | WO |
| 0000 0000 000x 1110          | Clear Mask                  | WO |
| 0000 0000 000x 1111          | R/W All Mask Bits           | RW |

### **Ports C0-DF - Slave DMA Controller**

Channels 0-3 of the Slave DMA Controller control System DMA Channels 4-7. There are 16 Slave DMA Controller registers:

| <u>I/O Address Bits 15-0</u> | <u>Register Name</u>        |    |
|------------------------------|-----------------------------|----|
| 0000 0000 1100 000x          | Ch 4 Base / Current Address | RW |
| 0000 0000 1100 001x          | Ch 4 Base / Current Count   | RW |
| 0000 0000 1100 010x          | Ch 5 Base / Current Address | RW |
| 0000 0000 1100 011x          | Ch 5 Base / Current Count   | RW |
| 0000 0000 1100 100x          | Ch 6 Base / Current Address | RW |
| 0000 0000 1100 101x          | Ch 6 Base / Current Count   | RW |
| 0000 0000 1100 110x          | Ch 7 Base / Current Address | RW |
| 0000 0000 1100 111x          | Ch 7 Base / Current Count   | RW |
| 0000 0000 1101 000x          | Status / Command            | RW |
| 0000 0000 1101 001x          | Write Request               | WO |
| 0000 0000 1101 010x          | Write Single Mask           | WO |
| 0000 0000 1101 011x          | Write Mode                  | WO |
| 0000 0000 1101 100x          | Clear Byte Pointer F/F      | WO |
| 0000 0000 1101 101x          | Master Clear                | WO |
| 0000 0000 1101 110x          | Clear Mask                  | WO |
| 0000 0000 1101 111x          | Read/Write All Mask Bits    | WO |

Note that not all bits of the address are decoded.

The Master and Slave DMA Controllers are compatible with the Intel 8237 DMA Controller chip. Detailed description of 8237 DMA controller operation can be obtained from the Intel Peripheral Components Data Book and numerous other industry publications.

### **Ports 80-8F - DMA Page Registers**

There are eight DMA Page Registers, one for each DMA channel. These registers provide bits 16-23 of the 24-bit address for each DMA channel (bits 0-15 are stored in registers in the Master and Slave DMA Controllers). They are located at the following I/O Port addresses:

| <u>I/O Address Bits 15-0</u> | <u>Register Name</u>           |    |
|------------------------------|--------------------------------|----|
| 0000 0000 1000 0111          | Channel 0 DMA Page (M-0).....  | RW |
| 0000 0000 1000 0011          | Channel 1 DMA Page (M-1).....  | RW |
| 0000 0000 1000 0001          | Channel 2 DMA Page (M-2).....  | RW |
| 0000 0000 1000 0010          | Channel 3 DMA Page (M-3).....  | RW |
| 0000 0000 1000 1111          | Channel 4 DMA Page (S-0) ..... | RW |
| 0000 0000 1000 1011          | Channel 5 DMA Page (S-1) ..... | RW |
| 0000 0000 1000 1001          | Channel 6 DMA Page (S-2) ..... | RW |
| 0000 0000 1000 1010          | Channel 7 DMA Page (S-3) ..... | RW |

### **DMA Controller Shadow Registers**

The DMA Controller shadow registers are enabled by setting function 0 Rx77 bit 0. If the shadow registers are enabled, they are read back at the indicated I/O port instead of the standard DMA controller registers (writes are unchanged).

|                                                                               |                  |
|-------------------------------------------------------------------------------|------------------|
| <b><u>Port 0 –Channel 0 Base Address .....</u></b>                            | <b><u>RO</u></b> |
| <b><u>Port 1 –Channel 0 Byte Count .....</u></b>                              | <b><u>RO</u></b> |
| <b><u>Port 2 –Channel 1 Base Address .....</u></b>                            | <b><u>RO</u></b> |
| <b><u>Port 3 –Channel 1 Byte Count .....</u></b>                              | <b><u>RO</u></b> |
| <b><u>Port 4 –Channel 2 Base Address .....</u></b>                            | <b><u>RO</u></b> |
| <b><u>Port 5 –Channel 2 Byte Count .....</u></b>                              | <b><u>RO</u></b> |
| <b><u>Port 6 –Channel 3 Base Address .....</u></b>                            | <b><u>RO</u></b> |
| <b><u>Port 7 –Channel 3 Byte Count .....</u></b>                              | <b><u>RO</u></b> |
| <b><u>Port 8 –1<sup>st</sup> Read Channel 0-3 Command Register .....</u></b>  | <b><u>RO</u></b> |
| <b><u>Port 8 –2<sup>nd</sup> Read Channel 0-3 Request Register .....</u></b>  | <b><u>RO</u></b> |
| <b><u>Port 8 –3<sup>rd</sup> Read Channel 0 Mode Register .....</u></b>       | <b><u>RO</u></b> |
| <b><u>Port 8 –4<sup>th</sup> Read Channel 1 Mode Register .....</u></b>       | <b><u>RO</u></b> |
| <b><u>Port 8 –5<sup>th</sup> Read Channel 2 Mode Register .....</u></b>       | <b><u>RO</u></b> |
| <b><u>Port 8 –6<sup>th</sup> Read Channel 3 Mode Register .....</u></b>       | <b><u>RO</u></b> |
| <b><u>Port F –Channel 0-3 Read All Mask .....</u></b>                         | <b><u>RO</u></b> |
| <b><u>Port C4 –Channel 5 Base Address .....</u></b>                           | <b><u>RO</u></b> |
| <b><u>Port C6 –Channel 5 Byte Count .....</u></b>                             | <b><u>RO</u></b> |
| <b><u>Port C8 –Channel 6 Base Address .....</u></b>                           | <b><u>RO</u></b> |
| <b><u>Port CA –Channel 6 Byte Count .....</u></b>                             | <b><u>RO</u></b> |
| <b><u>Port CC –Channel 7 Base Address .....</u></b>                           | <b><u>RO</u></b> |
| <b><u>Port CE –Channel 7 Byte Count .....</u></b>                             | <b><u>RO</u></b> |
| <b><u>Port D0 –1<sup>st</sup> Read Channel 4-7 Command Register .....</u></b> | <b><u>RO</u></b> |
| <b><u>Port D0 –2<sup>nd</sup> Read Channel 4-7 Request Register .....</u></b> | <b><u>RO</u></b> |
| <b><u>Port D0 –3<sup>rd</sup> Read Channel 4 Mode Register .....</u></b>      | <b><u>RO</u></b> |
| <b><u>Port D0 –4<sup>th</sup> Read Channel 5 Mode Register .....</u></b>      | <b><u>RO</u></b> |
| <b><u>Port D0 –5<sup>th</sup> Read Channel 6 Mode Register .....</u></b>      | <b><u>RO</u></b> |
| <b><u>Port D0 –6<sup>th</sup> Read Channel 7 Mode Register .....</u></b>      | <b><u>RO</u></b> |
| <b><u>Port DE –Channel 4-7 Read All Mask .....</u></b>                        | <b><u>RO</u></b> |

## Interrupt Controller Registers

### Ports 20-21 - Master Interrupt Controller

The Master Interrupt Controller controls system interrupt channels 0-7. Two registers control the Master Interrupt Controller. They are:

| <u>I/O Address Bits 15-0</u> | <u>Register Name</u>            |           |
|------------------------------|---------------------------------|-----------|
| <b>0000 0000 001x xxx0</b>   | <b>Master Interrupt Control</b> | <b>RW</b> |
| <b>0000 0000 001x xxx1</b>   | <b>Master Interrupt Mask</b>    | <b>RW</b> |

Note that not all bits of the address are decoded.

The Master Interrupt Controller is compatible with the Intel 8259 Interrupt Controller chip. Detailed descriptions of 8259 Interrupt Controller operation can be obtained from the Intel Peripheral Components Data Book and numerous other industry publications.

### Ports A0-A1 - Slave Interrupt Controller

The Slave Interrupt Controller controls system interrupt channels 8-15. The slave system interrupt controller also occupies two register locations:

| <u>I/O Address Bits 15-0</u> | <u>Register Name</u>           |           |
|------------------------------|--------------------------------|-----------|
| <b>0000 0000 101x xxx0</b>   | <b>Slave Interrupt Control</b> | <b>RW</b> |
| <b>0000 0000 101x xxx1</b>   | <b>Slave Interrupt Mask</b>    | <b>RW</b> |

Note that not all address bits are decoded.

The Slave Interrupt Controller is compatible with the Intel 8259 Interrupt Controller chip. Detailed descriptions of 8259 Interrupt Controller operation can be obtained from the Intel Peripheral Components Data Book and numerous other industry publications.

## Interrupt Controller Shadow Registers

The following shadow registers are enabled by setting function 0 Rx47[4]. If the shadow registers are enabled, they are read back at the indicated I/O port instead of the standard interrupt controller registers (writes are unchanged).

|                                                        |                          |                |
|--------------------------------------------------------|--------------------------|----------------|
| <b>Port 20 - Master Interrupt Control Shadow .....</b> |                          | <b>RO</b>      |
| <b>Port A0 - Slave Interrupt Control Shadow .....</b>  |                          | <b>RO</b>      |
| <b>7</b>                                               | <b>Reserved</b> .....    | always reads 0 |
| <b>6</b>                                               | <b>OCW3 bit 2 (POLL)</b> |                |
| <b>5</b>                                               | <b>OCW3 bit 0 (RIS)</b>  |                |
| <b>4</b>                                               | <b>OCW3 bit 5 (SMM)</b>  |                |
| <b>3</b>                                               | <b>OCW2 bit 7 (R)</b>    |                |
| <b>2</b>                                               | <b>ICW4 bit 4 (SFNM)</b> |                |
| <b>1</b>                                               | <b>ICW4 bit 1 (AEOI)</b> |                |
| <b>0</b>                                               | <b>ICW1 bit 3 (LTIM)</b> |                |

### Port 21 - Master Interrupt Mask Shadow .....

### Port A1 - Slave Interrupt Mask Shadow .....

|            |                                          |                |
|------------|------------------------------------------|----------------|
| <b>7-5</b> | <b>Reserved</b> .....                    | always reads 0 |
| <b>4-0</b> | <b>T7-T3 of Interrupt Vector Address</b> |                |

## Timer / Counter Registers

### Ports 40-43 - Timer / Counter Registers

There are 4 Timer / Counter registers:

| <u>I/O Address Bits 15-0</u> | <u>Register Name</u>            |           |
|------------------------------|---------------------------------|-----------|
| <b>0000 0000 010x xx00</b>   | <b>Timer / Counter 0 Count</b>  | <b>RW</b> |
| <b>0000 0000 010x xx01</b>   | <b>Timer / Counter 1 Count</b>  | <b>RW</b> |
| <b>0000 0000 010x xx10</b>   | <b>Timer / Counter 2 Count</b>  | <b>RW</b> |
| <b>0000 0000 010x xx11</b>   | <b>Timer / Counter Cmd Mode</b> | <b>WO</b> |

Note that not all bits of the address are decoded.

The Timer / Counters are compatible with the Intel 8254 Timer / Counter chip. Detailed descriptions of 8254 Timer / Counter operation can be obtained from the Intel Peripheral Components Data Book and numerous other industry publications.

## Timer / Counter Shadow Registers

The following shadow registers are enabled for readback by setting function 0 Rx47[4]. If the shadow registers are enabled, they are read back at the indicated I/O port instead of the standard timer / counter registers (writes are unchanged).

|                                                                                     |  |           |
|-------------------------------------------------------------------------------------|--|-----------|
| <b>Port 40 – Counter 0 Base Count Value (LSB 1<sup>st</sup> MSB 2<sup>nd</sup>)</b> |  | <b>RO</b> |
| <b>Port 41 – Counter 1 Base Count Value (LSB 1<sup>st</sup> MSB 2<sup>nd</sup>)</b> |  | <b>RO</b> |
| <b>Port 42 – Counter 2 Base Count Value (LSB 1<sup>st</sup> MSB 2<sup>nd</sup>)</b> |  | <b>RO</b> |

**CMOS / RTC Registers**
**Port 70 - CMOS Address.....RW**

- 7 **NMI Disable**..... RW  
 0 Enable NMI Generation. NMI is asserted on encountering IOCHCK# on the ISA bus or SERR# on the PCI bus.  
 1 Disable NMI Generation .....default

**6-0 CMOS Address (lower 128 bytes)..... RW**
**Port 71 - CMOS Data.....RW**
**7-0 CMOS Data (128 bytes)**

Note: Ports 70-71 may be accessed if Rx5A bit-2 is set to one to select the internal RTC. If Rx5A bit-2 is set to zero, accesses to ports 70-71 will be directed to an external RTC.

**Port 72 - CMOS Address.....RW**
**7-0 CMOS Address (256 bytes)..... RW**
**Port 73 - CMOS Data.....RW**
**7-0 CMOS Data (256 bytes)**

Note: Ports 72-73 may be accessed if Rx5A bit-2 is set to one to select the internal RTC. If Rx5A bit-2 is set to zero, accesses to ports 72-73 will be directed to an external RTC.

**Port 74 - CMOS Address.....RW**
**7-0 CMOS Address (256 bytes)..... RW**
**Port 75 - CMOS Data.....RW**
**7-0 CMOS Data (256 bytes)**

Note: Ports 74-75 may be accessed only if Function 0 Rx5B bit-1 is set to one to enable the internal RTC SRAM and if Rx48 bit-3 (Port 74/75 Access Enable) is set to one to enable port 74/75 access.

Note: Ports 70-71 are compatible with PC industry-standards and may be used to access the lower 128 bytes of the 256-byte on-chip CMOS RAM. Ports 72-73 may be used to access the full extended 256-byte space. Ports 74-75 may be used to access the full on-chip extended 256-byte space in cases where the on-chip RTC is disabled.

Note: The system Real Time Clock (RTC) is part of the "CMOS" block. The RTC control registers are located at specific offsets in the CMOS data area (0-0Dh and 7D-7Fh). Detailed descriptions of CMOS / RTC operation and programming can be obtained from the VIA VT82887 Data Book or numerous other industry publications. For reference, the definition of the RTC register locations and bits are summarized in the following table:

| Offset | Description      | Binary Range                                       | BCD Range                  |
|--------|------------------|----------------------------------------------------|----------------------------|
| 00     | Seconds          | 00-3Bh                                             | 00-59h                     |
| 01     | Seconds Alarm    | 00-3Bh                                             | 00-59h                     |
| 02     | Minutes          | 00-3Bh                                             | 00-59h                     |
| 03     | Minutes Alarm    | 00-3Bh                                             | 00-59h                     |
| 04     | Hours            | am 12hr: 01-1Ch<br>pm 12hr: 81-8Ch<br>24hr: 00-17h | 01-12h<br>81-92h<br>00-23h |
| 05     | Hours Alarm      | am 12hr: 01-1Ch<br>pm 12hr: 81-8Ch<br>24hr: 00-17h | 01-12h<br>81-92h<br>00-23h |
| 06     | Day of the Week  | Sun=1: 01-07h                                      | 01-07h                     |
| 07     | Day of the Month | 01-1Fh                                             | 01-31h                     |
| 08     | Month            | 01-0Ch                                             | 01-12h                     |
| 09     | Year             | 00-63h                                             | 00-99h                     |

**0A Register A**

- 7 **UIP** Update In Progress  
 6-4 **DV2-0** Divide (010=ena osc & keep time)  
 3-0 **RS3-0** Rate Select for Periodic Interrupt

**0B Register B**

- 7 **SET** Inhibit Update Transfers  
 6 **PIE** Periodic Interrupt Enable  
 5 **AIE** Alarm Interrupt Enable  
 4 **UIE** Update Ended Interrupt Enable  
 3 **SQWE** No function (read/write bit)  
 2 **DM** Data Mode (0=BCD, 1=binary)  
 1 **24/12** Hours Byte Format (0=12, 1=24)  
 0 **DSE** Daylight Savings Enable

**0C Register C**

- 7 **IRQF** Interrupt Request Flag  
 6 **PF** Periodic Interrupt Flag  
 5 **AF** Alarm Interrupt Flag  
 4 **UF** Update Ended Flag  
 3-0 **0** Unused (always read 0)

**0D Register D**

- 7 **VRT** Reads 1 if VBAT voltage is OK  
 6-0 **0** Unused (always read 0)

**0E-7C Software-Defined Storage Registers (111 Bytes)**

| Offset | Extended Functions | Binary Range | BCD Range |
|--------|--------------------|--------------|-----------|
| 7D     | Date Alarm         | 01-1Fh       | 01-31h    |
| 7E     | Month Alarm        | 01-0Ch       | 01-12h    |
| 7F     | Century Field      | 13-14h       | 19-20h    |

**80-FF Software-Defined Storage Registers (128 Bytes)**
**Table 5. CMOS Register Summary**

### **Super-I/O Configuration Index / Data Registers**

Super-I/O configuration registers are accessed by performing I/O operations to / from an index / data pair of registers in system I/O space at port addresses 3F0h and 3F1h. The configuration registers accessed using this mechanism are used to configure the Super-I/O registers (parallel port, serial ports, IR port, and floppy controller).

Super I/O configuration is accomplished in three steps:

- 1) Enter configuration mode (set Function 0 Rx85[1] = 1)
- 2) Configure the chip
  - a) Write index to port 3F0
  - b) Read / write data from / to port 3F1
  - c) Repeat a and b for all desired registers
- 3) Exit configuration mode (set Function 0 Rx85[1] = 0)

#### **Port 3F0h – Super-I/O Configuration Index.....RW**

##### **7-0 Index value**

Function 0 PCI configuration space register Rx85[1] must be set to 1 to enable access to the Super-I/O configuration registers.

#### **Port 3F1h – Super-I/O Configuration Data.....RW**

##### **7-0 Data value**

This register shares a port with the Floppy Status Port (which is read only). This port is accessible only when Rx85[1] is set to 1 (the floppy status port is accessed if Rx85[1] = 0).

### **Super-I/O Configuration Registers**

These registers are accessed via the port 3F0 / 3F1 index / data register pair using the indicated index values below

#### **Index E0 – Super-I/O Device ID.....RO**

**7-0 Super-I/O ID** ..... default = 3Ch

#### **Index E1 – Super-I/O Device Revision.....RO**

**7-0 Super-I/O Revision Code** ..... default = 0

#### **Index E2 – Super-I/O Function Select .....RW**

**7-5 Reserved** ..... always reads 0

##### **4 Floppy Controller Enable**

0 Disable..... default  
1 Enable

##### **3 Serial Port 2 Enable**

0 Disable..... default  
1 Enable

##### **2 Serial Port 1 Enable**

0 Disable..... default  
1 Enable

##### **1-0 Parallel Port Mode / Enable**

00 Unidirectional mode ..... default  
01 ECP  
10 EPP  
11 Parallel Port Disabled

#### **Index E3 – Floppy Controller I/O Base Address .....RW**

**7-2 I/O Address 9-4**..... default = 0

**1-0 Must be 0** ..... default = 0

#### **Index E6 – Parallel Port I/O Base Address .....RW**

**7-0 I/O Address 9-2**..... default = 0

If EPP is not enabled, the parallel port can be set to 192 locations on 4-byte boundaries from 100h to 3FCh. If EPP is enabled, the parallel port can be set to 96 locations on 8-byte boundaries from 100h to 3F8h.

#### **Index E7 – Serial Port 1 I/O Base Address.....RW**

**7-1 I/O Address 9-3**..... default = 0

**0 Must be 0** ..... default = 0

#### **Index E8 – Serial Port 2 I/O Base Address.....RW**

**7-1 I/O Address 9-3**..... default = 0

**0 Must be 0** ..... default = 0

**Index EE – Serial Port Configuration .....RW**

- 7 Serial Port 2 High Speed Enable**
  - 0 Disable .....default
  - 1 Enable
- 6 Serial Port 1 High Speed Enable**
  - 0 Disable .....default
  - 1 Enable
- 5-3 Serial Port 2 Mode**
  - 000 Standard
  - 001 IrDA (HIPSIR)
  - 010 Amplitude shift keyed IR @ 500KHz
  - 011 -reserved-
  - 1xx -reserved-
- 2 Serial Port 2 Half Duplex**
  - 0 Disable .....default
  - 1 Enable
- 1 Serial Port 2 TX Output Inversion**
  - 0 Disable .....default
  - 1 Enable
- 0 Serial Port 2 RX Input Inversion**
  - 0 Disable .....default
  - 1 Enable

**Index EF – Power Down Control.....RW**

- 7-6 Reserved** ..... always reads 0
- 5 Clock Power Down**
  - 0 Normal operation .....default
  - 1 Power Down
- 4 Parallel Port Power Down**
  - 0 Normal operation .....default
  - 1 Power Down
- 3 Serial Port 2 Power Down**
  - 0 Normal operation .....default
  - 1 Power Down
- 2 Serial Port 1 Power Down**
  - 0 Normal operation .....default
  - 1 Power Down
- 1 FDC Power Down**
  - 0 Normal operation .....default
  - 1 Power Down
- 0 All Power Down**
  - 0 Normal operation .....default
  - 1 Power Down All

**Index F0 – Parallel Port Control..... RW**

- 7 PS2 Type BiDirectionl Parallel Port**
  - 0 Disable..... default
  - 1 Enable
- 6 EPP Direction by Register not by IOW**
  - 0 Disable..... default
  - 1 Enable
- 5 EPP+ECP**
  - 0 Disable..... default
  - 1 Enable
- 4 EPP Version**
  - 0 Version 1.9 ..... default
  - 1 Version 1.7
- 3-0 Reserved** .....always reads 0

**Index F1 – Serial Port Control..... RW**

- 7-6 Reserved** ..... always reads 0
- 5 IR Loop Back**
  - 0 Disable..... default
  - 1 Enable
- 4 Serial Port 2 Power-Down State**
  - 0 Normal..... default
  - 1 Tristate output in power down mode
- 3 Serial Port 1 Power-Down State**
  - 0 Normal..... default
  - 1 Tristate output in power down mode
- 2 IR Dedicated Pin (IRTX/IRRX) Select**
  - 0 IRTX / IRRX Output from Serial Port 2..... def
  - 1 Function 0 Rx76[5] = 0:
    - IRRX output from dedicated pin D12
    - IRTX output from dedicated pin E12
- 1-0 Reserved** .....always reads 0

**Index F2 – Test Mode (Do Not Program)..... RW**
**Index F4 – Test Mode (Do Not Program)..... RW**



**Index F6 – Floppy Controller Configuration.....RW**

- 7-6 **Reserved** ..... always reads 0
- 5 **Floppy Drive On Parallel Port**
- 0 Parallel Port (SPP) Mode .....default
- 1 FDC Mode

This bit is used in notebook applications to allow attachment of an external floppy drive using the parallel port I/O connector:

| <u>SPP Mode</u> | <u>Pin Type</u> | <u>FDC Mode</u> | <u>Pin Type</u> |
|-----------------|-----------------|-----------------|-----------------|
| STROBE#         | I/O             | -               | n/a             |
| PD0             | I/O             | INDEX#          | I               |
| PD1             | I/O             | TRK00#          | I               |
| PD2             | I/O             | WRTprt#         | I               |
| PD3             | I/O             | RDATA#          | I               |
| PD4             | I/O             | DSKCHG#         | I               |
| PD5             | I/O             | -               | n/a             |
| PD6             | I/O             | -               | n/a             |
| PD7             | I/O             | -               | n/a             |
| ACK#            | I               | DS1#            | O               |
| BUSY            | I               | MTR1#           | O               |
| PE              | I               | WDATA#          | O               |
| SLCT            | I               | WGATE#          | O               |
| AUTOFD#         | I/O             | DRVEN0          | O               |
| ERROR#          | I               | HDSEL#          | O               |
| PINIT#          | I/O             | DIR#            | O               |
| SLCTIN#         | I/O             | STEP#           | O               |

- 4 **3-Mode FDD**
- 0 Disable .....default
- 1 Enable
- 3 **Reserved** ..... always reads 0
- 2 **Four Floppy Drive Option**
- 0 Internal 2-Drive Decoder .....default
- 1 External 4-Drive Decoder
- 1 **FDC DMA Non-Burst**
- 0 Burst .....default
- 1 Non-Burst
- 0 **FDC Swap**
- 0 Disable .....default
- 1 Enable

**Index F8 – Floppy Drive Control ..... RW**

- 7-6 **Floppy Drive 3** (see table below)
- 5-4 **Floppy Drive 2** (see table below)
- 3-2 **Floppy Drive 1** (see table below)
- 1-0 **Floppy Drive 0** (see table below)

|    | <u>DRVEN1</u> | <u>DRVEN0</u> |
|----|---------------|---------------|
| 00 | DRATE0        | DENSEL        |
| 01 | DRATE0        | DRATE1        |
| 10 | DRATE0        | DENSEL#       |
| 11 | DRATE1        | DRATE0        |

## Super-I/O I/O Ports

### Floppy Disk Controller Registers

These registers are located at I/O ports which are offsets from "FDCBase" (index C3h of the Super-I/O configuration registers). FDCBase is typically set to allow these ports to be accessed at the standard floppy disk controller address range of 3F0-3F7h.

#### Port FDCBase+2 – FDC Command.....RW

- 7 **Motor 3 (unused in VT8231: no MTR3# pin)**
- 6 **Motor 2 (unused in VT8231: no MTR2# pin)**
- 5 **Motor 1**
  - 0 Motor Off
  - 1 Motor On
- 4 **Motor 0**
  - 0 Motor Off
  - 1 Motor On
- 3 **DMA and IRQ Channels**
  - 0 Disabled
  - 1 Enabled
- 2 **FDC Reset**
  - 0 Execute FDC Reset
  - 1 FDC Enabled
- 1-0 **Drive Select**
  - 00 Select Drive 0
  - 01 Select Drive 1
  - 1x -reserved-

#### Port FDCBase+4 – FDC Main Status.....RO

- 7 **Main Request**
  - 0 Data register not ready
  - 1 Data register ready
- 6 **Data Input / Output**
  - 0 CPU => FDC
  - 1 FDC => CPU
- 5 **Non-DMA Mode**
  - 0 FDC in DMA mode
  - 1 FDC not in DMA mode
- 4 **FDC Busy**
  - 0 FDC inactive
  - 1 FDC active
- 3-2 **Reserved** ..... always reads 0
- 1 **Drive 1 Active**
  - 0 Drive inactive
  - 1 Drive performing a positioning change
- 0 **Drive 0 Active**
  - 0 Drive inactive
  - 1 Drive performing a positioning change

#### Port FDCBase+4 – FDC Data Rate Select..... WO

#### Port FDCBase+5 – FDC Data..... RW

#### Port FDCBase+7 – FDC Disk Change Status..... RO

- 7 **Disk Change**
  - 0 Floppy not changed
  - 1 Floppy changed since last instruction
- 6-3 **Undefined** ..... always read 1
- 2-1 **Data Rate**
  - 00 500 Kbit/sec (1.2MB 5" or 1.44 MB 3" drive)
  - 01 300 Kbit/sec (360KB 5" drive)
  - 10 250 Kbit/sec (720KB 3" drive)
  - 11 1 Mbit/sec
- 0 **High Density Rate**
  - 0 500 Kbit/sec or 1 Mbit/sec selected
  - 1 250 Kbit/sec or 300 Kbit/sec selected

#### Port FDCBase+7 – FDC Configuration Control..... WO

- 7-2 **Undefined** ..... always read 1
- 1-0 **Data Rate**
  - 00 500 Kbit/sec (1.2MB 5" or 1.44 MB 3" drive)
  - 01 300 Kbit/sec (360KB 5" drive)
  - 10 250 Kbit/sec (720KB 3" drive)
  - 11 1 Mbit/sec



## **Parallel Port Registers**

These registers are located at I/O ports which are offsets from “LPTBase” (index C6h of the Super-I/O configuration registers). LPTBase is typically set to allow these ports to be accessed at the standard parallel port address range of 378-37Fh.

### **Port LPTBase+0 – Parallel Port Data .....RW**

#### **7-0 Parallel Port Data**

### **Port LPTBase+1 – Parallel Port Status.....RO**

- 7 BUSY#**
  - 0 Printer busy, offline, or error
  - 1 Printer not busy
- 6 ACK#**
  - 0 Data transfer to printer complete
  - 1 Data transfer to printer in progress
- 5 PE**
  - 0 Paper available
  - 1 No paper available
- 4 SLCT**
  - 0 Printer offline
  - 1 Printer online
- 3 ERROR#**
  - 0 Printer error
  - 1 Printer OK
- 2-0 Reserved** ..... always read 1 bits

### **Port LPTBase+3 – Parallel Port EPP Address..... RW**

### **Port LPTBase+4 – Parallel Port EPP Data Port 0..... RW**

### **Port LPTBase+5 – Parallel Port EPP Data Port 1..... RW**

### **Port LPTBase+6 – Parallel Port EPP Data Port 2..... RW**

### **Port LPTBase+7 – Parallel Port EPP Data Port 3..... RW**

### **Port LPTBase+400h – Parallel Port ECP Data / Cfg A RW**

### **Port LPTBase+401h – Parallel Port ECP Config B..... RW**

### **Port LPTBase+401h – Parallel Port ECP Extd Ctrl..... RW**

### **Port LPTBase+2 – Parallel Port Control .....RW**

- 7-5 Undefined** ..... always read back 1
- 4 Hardware Interrupt**
  - 0 Disable .....default
  - 1 Enable
- 3 Printer Select**
  - 0 Deselect printer .....default
  - 1 Select printer
- 2 Printer Initialize**
  - 0 Initialize Printer.....default
  - 1 Allow printer to operate normally
- 1 Automatic Line Feed**
  - 0 Host handles line feeds.....default
  - 1 Printer does automatic line feeds
- 0 Strobe**
  - 0 No data transfer .....default
  - 1 Transfer data to printer

### Serial Port 1 Registers

These registers are located at I/O ports which are offsets from "COM1Base" (index C7h of the Super-I/O configuration registers). COM1Base is typically set to allow these ports to be accessed at the standard serial port 1 address range of 3F8-3FFh.

#### Port COM1Base+0 – Transmit / Receive Buffer .....RW

7-0 Serial Data

#### Port COM1Base+1 – Interrupt Enable .....RW

7-4 Undefined .....always read 0  
 3 Interrupt on Hnadshake Input State Change  
 2 Intr on Parity, Overrun, Framing Error or Break  
 1 Interrupt on Transmit Buffer Empty  
 0 Interrupt on Receive Data Ready

#### Port COM1Base+2 – Interrupt Status .....RO

7-3 Undefined .....always read 0  
 2-1 Interrupt ID (0=highest priority)  
     00 Priority 3 (Handshake Input Changed State)  
     01 Priority 2 (Transmit Buffer Empty)  
     10 Priority 1 (Data Received)  
     11 Priority 0 (Serialization Error or Break)  
 0 Interrupt Pending  
     0 Interrupt Pending  
     1 No Interrupt Pending

#### Port COM1Base+2 – FIFO Control ..... WO

#### Port COM1Base+3 – UART Control.....RW

7 Divisor Latch Access  
     0 Select transmit / receive registers  
     1 Select divisor latch  
 6 Break  
     0 Break condition off  
     1 Break condition on  
 5-3 Parity  
     000 None  
     001 Odd  
     011 Even  
     101 Mark  
     111 Space  
 2 Stop Bits  
     0 1  
     1 2  
 1-0 Data Bits  
     00 5  
     01 6  
     10 7  
     11 8

#### Port COM1Base+4 – Handshake Control ..... RW

7-5 Undefined ..... always read 0  
 4 Loopback Check  
     0 Normal operation  
     1 Loopback enabled  
 3 General Purpose Output 2 (unused in VT8231)  
 2 General Purpose Output 1 (unused in VT8231)  
 1 Request To Send  
     0 Disabled  
     1 Enabled  
 0 Data Terminal Ready  
     0 Disabled  
     1 Enabled

#### Port COM1Base+5 – UART Status..... RW

7 Undefined ..... always read 0  
 6 Transmitter Empty  
     0 1 byte in transmit hold or transmit shift register  
     1 0 bytes transmit hold and transmit shift regs  
 5 Transmit Buffer Empty  
     0 1 byte in transmit hold register  
     1 Transmit hold register empty  
 4 Break Detected  
     0 No break detected  
     1 Break detected  
 3 Framing Error Detected  
     0 No error  
     1 Error  
 2 Parity Error Detected  
     0 No error  
     1 Error  
 1 Overrun Error Detected  
     0 No error  
     1 Error  
 0 Received Data Ready  
     0 No received data available  
     1 Received data in receiver buffer register

#### Port COM1Base+6 – Handshake Status..... RW

7 DCD Status (1=Active, 0=Inactive)  
 6 RI Status (1=Active, 0=Inactive)  
 5 DSR Status (1=Active, 0=Inactive)  
 4 CTS Status (1=Active, 0=Inactive)  
 3 DCD Changed (1=Changed Since Last Read)  
 2 RI Changed (1=Changed Since Last Read)  
 1 DSR Changed (1=Changed Since Last Read)  
 0 CTS Changed (1=Changed Since Last Read)

#### Port COM1Base+7 – Scratchpad ..... RW

7 Scratchpad Data

#### Port COM1Base+9-8 – Baud Rate Generator Divisor .. RW

15-0 Divisor Value for Basud Rate Generator  
 Baud Rate = 115,200 / Divisor  
 (e.g., setting this register to 1 selects 115.2 Kbaud)

## **Serial Port 2 Registers**

These registers are located at I/O ports which are offsets from "COM2Base" (index C8h of the Super-I/O configuration registers). COM2Base is typically set to allow these ports to be accessed at the standard serial port 2 address range of 2F8-2FFh.

### **Port COM1Base+0 – Transmit / Receive Buffer .....RW**

7-0 Serial Data

### **Port COM1Base+1 – Interrupt Enable .....RW**

7-4 Undefined .....always read 0  
 3 Interrupt on Hnadshake Input State Change  
 2 Intr on Parity, Overrun, Framing Error or Break  
 1 Interrupt on Transmit Buffer Empty  
 0 Interrupt on Receive Data Ready

### **Port COM1Base+2 – Interrupt Status .....RO**

7-3 Undefined .....always read 0  
 2-1 Interrupt ID (0=highest priority)  
     00 Priority 3 (Handshake Input Changed State)  
     01 Priority 2 (Transmit Buffer Empty)  
     10 Priority 1 (Data Received)  
     11 Priority 0 (Serialization Error or Break)  
 0 Interrupt Pending  
     0 Interrupt Pending  
     1 No Interrupt Pending

### **Port COM1Base+2 – FIFO Control ..... WO**

### **Port COM1Base+3 – UART Control.....RW**

7 Divisor Latch Access  
     0 Select transmit / receive registers  
     1 Select divisor latch  
 6 Break  
     0 Break condition off  
     1 Break condition on  
 5-3 Parity  
     000 None  
     001 Odd  
     011 Even  
     101 Mark  
     111 Space  
 2 Stop Bits  
     0 1  
     1 2  
 1-0 Data Bits  
     00 5  
     01 6  
     10 7  
     11 8

### **Port COM1Base+4 – Handshake Control ..... RW**

7-5 Undefined ..... always read 0  
 4 Loopback Check  
     0 Normal operation  
     1 Loopback enabled  
 3 General Purpose Output 2 (unused in VT8231)  
 2 General Purpose Output 1 (unused in VT8231)  
 1 Request To Send  
     0 Disabled  
     1 Enabled  
 0 Data Terminal Ready  
     0 Disabled  
     1 Enabled

### **Port COM1Base+5 – UART Status..... RW**

7 Undefined ..... always read 0  
 6 Transmitter Empty  
     0 1 byte in transmit hold or transmit shift register  
     1 0 bytes transmit hold and transmit shift regs  
 5 Transmit Buffer Empty  
     0 1 byte in transmit hold register  
     1 Transmit hold register empty  
 4 Break Detected  
     0 No break detected  
     1 Break detected  
 3 Framing Error Detected  
     0 No error  
     1 Error  
 2 Parity Error Detected  
     0 No error  
     1 Error  
 1 Overrun Error Detected  
     0 No error  
     1 Error  
 0 Received Data Ready  
     0 No received data available  
     1 Received data in receiver buffer register

### **Port COM1Base+6 – Handshake Status..... RW**

7 DCD Status (1=Active, 0=Inactive)  
 6 RI Status (1=Active, 0=Inactive)  
 5 DSR Status (1=Active, 0=Inactive)  
 4 CTS Status (1=Active, 0=Inactive)  
 3 DCD Changed (1=Changed Since Last Read)  
 2 RI Changed (1=Changed Since Last Read)  
 1 DSR Changed (1=Changed Since Last Read)  
 0 CTS Changed (1=Changed Since Last Read)

### **Port COM1Base+7 – Scratchpad ..... RW**

7 Scratchpad Data

### **Port COM1Base+9-8 – Baud Rate Generator Divisor .. RW**

15-0 Divisor Value for Basud Rate Generator  
 Baud Rate = 115,200 / Divisor  
 (e.g., setting this register to 1 selects 115.2 Kbaud)

### SoundBlaster Pro Port Registers

These registers are located at offsets from "SBPBase" (defined in Rx43 of Audio Function 5 PCI configuration space). SBPBase is typically set to allow these ports to be accessed at the standard SoundBlaster Pro port address of 220h or 240h.

#### FM Registers

##### Port SBPBase+0 – FM Left Channel Index / Status.....RW

7-0 FM Right Channel Index / Status

##### Port SBPBase+1 – FM Left Channel Data..... WO

7-0 Right Channel FM Data

##### Port SBPBase+2 – FM Right Channel Index / Status....RW

7-0 FM Right Channel Index / Status

##### Port SBPBase+3 – FM Right Channel Data ..... WO

7-0 Right Channel FM Data

##### Port 388h or SBPBase+8 – FM Index / Status.....RW

7-0 FM Index / Status (Both Channels)

Writing to this port programs both the left and right channels (the write programs port offsets 0 and 2 as well)

##### Port 389h or SBPBase+9 – FM Data ..... WO

7-0 FM Data (Both Channels)

Writing to this port programs both the left and right channels (the write programs port offsets 1 and 3 as well)

#### Mixer Registers

##### Port SBPBase+4 – Mixer Index..... WO

7-0 Mixer Index

##### Port SBPBase+5 – Mixer Data.....RW

7-0 Mixer Data

### Sound Processor Registers

##### Port SBPBase+6 – Sound Processor Reset..... WO

0 1 = Sound Processor Reset

##### Port SBPBase+A – Sound Processor Read Data .....RO

7-0 Sound Processor Read Data

##### Port SBPBase+C – Sound Processor Command / Data WO

7-0 Sound Processor Command / Write Data

##### Port SBPBase+C – Sound Processor Buffer Status.....RO

7 1 = Sound Processor Command / Data Port Busy

##### Port SBPBase+E – Sound Processor Data Avail Status..RO

7 1 = Sound Processor Data Available

### Register Summary - FM

| Index | Bit-7                   | Bit-6 | Bit-5            | Bit-4 | Bit-3             | Bit-2 | Bit-1    | Bit-0 |       |
|-------|-------------------------|-------|------------------|-------|-------------------|-------|----------|-------|-------|
| 01    | Test                    |       |                  |       |                   |       |          |       |       |
| 02    | Fast Counter (80 usec)  |       |                  |       |                   |       |          |       |       |
| 03    | Slow Counter (320 usec) |       |                  |       |                   |       |          |       |       |
| 04    | IRQ                     | MFC   | MSC              |       |                   |       | SSSC     | SSFC  |       |
| 08    | CSM                     | SEL   |                  |       |                   |       |          |       |       |
| 20-35 | AM                      | VIB   | EGT              | KSR   | Multi             |       |          |       |       |
| 40-55 | KSL                     |       | Total Level (TL) |       |                   |       |          |       |       |
| 60-75 | Attack Rate (AR)        |       |                  |       | Decay Rate (DR)   |       |          |       |       |
| 80-95 | Sustain Level (SL)      |       |                  |       | Release Rate (RR) |       |          |       |       |
| A0-A8 | F-Number                |       |                  |       |                   |       |          |       |       |
| B0-B8 |                         |       | Key              | Block |                   |       | F-Number |       |       |
| BD    | Int                     | AM    | VIB              | Ryth  | Bass              | Snare | Tom      | Cym   | HiHat |
| C0-C8 |                         |       |                  |       | Feedback          |       |          | FM    |       |
| E0-F5 |                         |       |                  |       |                   |       | WS       |       |       |

MFC=Mask Fast Counter SSFC=Start / Stop Fast Counter  
 MSC=Mask Slow Counter SSSC=Start / Stop Slow Counter

### Register Summary – Mixer

| Index | Bit-7          | Bit-6 | Bit-5 | Bit-4 | Bit-3          | Bit-2   | Bit-1 | Bit-0 |
|-------|----------------|-------|-------|-------|----------------|---------|-------|-------|
| 00    | Data Reset     |       |       |       |                |         |       |       |
| 02    | SP Volume L    |       |       |       | SP Volume R    |         |       |       |
| 0A    |                |       |       |       |                | Mic Vol |       |       |
| 0C    |                |       | Finp  |       | TFIL           | Select  |       |       |
| 0E    |                |       | Fout  |       |                |         | ST    |       |
| 22    | General Volume |       |       |       | General Volume |         |       |       |
| 26    | FM Volume L    |       |       |       | FM Volume R    |         |       |       |
| 28    | CD Volume L    |       |       |       | CD Volume R    |         |       |       |
| 2E    | Line Volume L  |       |       |       | Line Volume R  |         |       |       |

Finp = Input Filter

Fout = Output Filter

TFIL = Input Filter Type

ST = Stereo / Mono Mode

Select = Input Choices (0=Microphone, 1=CD, 3=Line)

### Command Summary – Sound Processor (see next page)

**Command Summary – Sound Processor**

| <b>#</b> | <b>Type</b> | <b>Command</b>                               |
|----------|-------------|----------------------------------------------|
| 10       | Play        | 8 bits directly                              |
| 14       | Play        | 8 bits via DMA                               |
| 91       | Play        | High-speed 8 bits via DMA                    |
| 16       | Play        | 2-bit compressed via DMA                     |
| 17       | Play        | 2-bit compressed via DMA with reference      |
| 74       | Play        | 4-bit compressed via DMA                     |
| 75       | Play        | 4-bit compressed via DMA with reference      |
| 76       | Play        | 2.6-bit compressed via DMA                   |
| 77       | Play        | 2.6-bit compressed via DMA with reference    |
| 20       | Record      | Direct                                       |
| 24       | Record      | Via DMA                                      |
| 99       | Record      | High-speed 8 bits via DMA                    |
| D1       | Speaker     | Turn on speaker connection                   |
| D3       | Speaker     | Turn off speaker connection                  |
| D8       | Speaker     | Get speaker setting                          |
| 40       | Misc        | Set sample rate                              |
| 48       | Misc        | Set block length                             |
| 80       | Misc        | Set silence block                            |
| D0       | Misc        | Stop DMA                                     |
| D4       | Misc        | Continue DMA                                 |
| E1       | Misc        | Get version                                  |
| 30       | MIDI        | Direct MIDI input                            |
| 31       | MIDI        | MIDI input via interrupt                     |
| 32       | MIDI        | Direct MIDI input with time stamp            |
| 33       | MIDI        | MIDI input via interrupt with time stamp     |
| 34       | MIDI        | Direct MIDI UART mode                        |
| 35       | MIDI        | MIDI UART mode via interrupt                 |
| 36       | MIDI        | Direct MIDI UART mode with time stamp        |
| 37       | MIDI        | MIDI UART mode via interrupt with time stamp |
| 38       | MIDI        | Send MIDI code                               |

**Game Port Registers**

These registers are fixed at the standard game port address of 201h.

**I/O Port 201h – Game Port Status ..... RO**

|          |                                                       |
|----------|-------------------------------------------------------|
| <b>7</b> | <b>Joystick B Button 2 Status</b>                     |
| <b>6</b> | <b>Joystick B Button 1 Status</b>                     |
| <b>5</b> | <b>Joystick A Button 2 Status</b>                     |
| <b>4</b> | <b>Joystick A Button 1 Status</b>                     |
| <b>3</b> | <b>Joystick B One-Shot Status for Y-Potentiometer</b> |
| <b>2</b> | <b>Joystick B One-Shot Status for X-Potentiometer</b> |
| <b>1</b> | <b>Joystick A One-Shot Status for Y-Potentiometer</b> |
| <b>0</b> | <b>Joystick A One-Shot Status for X-Potentiometer</b> |

**I/O Port 201h – Start One-Shot..... WO**

**7-0** (Value Written is Ignored)

## **PCI Configuration Space I/O**

PCI configuration space accesses for functions 0-6 use PCI configuration mechanism 1 (see PCI specification revision 2.2 for more details). The ports respond only to double-word accesses. Byte or word accesses will be passed on unchanged.

### **Port CFB-CF8 - Configuration Address .....RW**

#### **31 Configuration Space Enable**

- 0 Disabled .....default
- 1 Convert configuration data port writes to configuration cycles on the PCI bus

**30-24 Reserved** ..... always reads 0

#### **23-16 PCI Bus Number**

Used to choose a specific PCI bus in the system

#### **15-11 Device Number**

Used to choose a specific device in the system

#### **10-8 Function Number**

Used to choose a specific function if the selected device supports multiple functions

#### **7-2 Register Number**

Used to select a specific DWORD in the device's configuration space

**1-0 Fixed** ..... always reads 0

### **Port CFF-CFC - Configuration Data .....RW**

There are 7 "functions" implemented in the VT8231:

| <b><u>Function #</u></b> | <b><u>Function</u></b>                     |
|--------------------------|--------------------------------------------|
| 0                        | PCI to ISA Bridge                          |
| 1                        | IDE Controller                             |
| 2                        | USB Controller Ports 0-1                   |
| 3                        | USB Controller Ports 2-3                   |
| 4                        | Power Management, SMBus & Hardware Monitor |
| 5                        | AC97 Audio Codec Controller                |
| 6                        | MC97 Modem Codec Controller                |

The following sections describe the registers and register bits of these functions.

## **Function 0 Registers - PCI to ISA Bridge**

All registers are located in the function 0 PCI configuration space of the VT8231. These registers are accessed through PCI configuration mechanism #1 via I/O address CF8/CFC.

### **PCI Configuration Space Header**

**Offset 1-0 - Vendor ID = 1106h.....RO**

**Offset 3-2 - Device ID = 8231h.....RO**

**Offset 5-4 - Command.....RW**

- 15-8 **Reserved** ..... always reads 0
- 7 **Address / Data Stepping**
  - 0 Disable
  - 1 Enable .....default
- 6-4 **Reserved** ..... always reads 0
- 3 **Special Cycle Enable** ..... Normally RW†, default = 0
- 2 **Bus Master** ..... always reads 1
- 1 **Memory Space** ..... Normally RO†, reads as 1
- 0 **I/O Space** ..... Normally RO†, reads as 1

† If the test bit at offset 46 bit-4 is set, access to the above indicated bits is reversed: bit-3 above becomes read only (reading back 1) and bits 0-1 above become read / write (with a default of 1).

**Offset 7-6 - Status.....RWC**

- 15 **Detected Parity Error** ..... write one to clear
- 14 **Signalled System Error** ..... always reads 0
- 13 **Signalled Master Abort** ..... write one to clear
- 12 **Received Target Abort** ..... write one to clear
- 11 **Signalled Target Abort** ..... write one to clear
- 10-9 **DEVSEL# Timing** ..... fixed at 01 (medium)
- 8 **Data Parity Detected** ..... always reads 0
- 7 **Fast Back-to-Back** ..... always reads 0
- 6-0 **Reserved** ..... always reads 0

**Offset 8 - Revision ID = nn.....RO**

- 7-0 **Revision ID**

**Offset 9 - Program Interface = 00h.....RO**

**Offset A - Sub Class Code = 01h.....RO**

**Offset B - Class Code = 06h.....RO**

**Offset E - Header Type = 80h.....RO**

- 7-0 **Header Type Code** .....80h (Multifunction Device)

**Offset F - BIST = 00h.....RO**

**Offset 2F-2C - Subsystem ID.....RO**

Use offset 70-73 to change the value returned.

## **ISA Bus Control**

**Offset 40 - ISA Bus Control..... RW**

- 7 **ISA Command Delay**
  - 0 Normal..... default
  - 1 Extra
- 6 **Extended ISA Bus Ready**
  - 0 Disable..... default
  - 1 Enable
- 5 **ISA Slave Wait States**
  - 0 4 Wait States..... default
  - 1 5 Wait States
- 4 **Chipset I/O Wait States**
  - 0 2 Wait States..... default
  - 1 4 Wait States
- 3 **I/O Recovery Time**
  - 0 Disable..... default
  - 1 Enable
- 2 **Extend-ALE**
  - 0 Disable..... default
  - 1 Enable
- 1 **ROM Wait States**
  - 0 1 Wait State ..... default
  - 1 0 Wait States
- 0 **ROM Write**
  - 0 Disable..... default
  - 1 Enable

**Offset 41 - ISA Test Mode..... RW**

- 7 **Bus Refresh Arbitration** (do not program) default=0
- 6 **XRDY Test Mode** (do not program) .....default=0
- 5 **Port 92 Fast Reset**
  - 0 Disable..... default
  - 1 Enable
- 4 **A20G Emulation** (do not program)..... default=0
- 3 **Double DMA Clock**
  - 0 Disable (DMA Clock = ½ ISA Clock)... default
  - 1 Enable (DMA Clock = ISA Clock)
- 2 **SHOLD Lock During INTA** (do not program) def=0
- 1 **Refresh Request Test Mode** (do not program).def=0
- 0 **ISA Refresh**
  - 0 Disable..... default
  - 1 Enable

This bit should be set to 1 for ISA compatibility.

**Offset 42 - ISA Clock Control.....RW**

- 7 **Latch IO16#**
  - 0 Enable (recommended setting) .....default
  - 1 Disable
- 6 **MCS16# Output**
  - 0 Disable .....default
  - 1 Enable
- 5 **Master Request Test Mode (do not program)**
  - 0 Disable .....default
  - 1 Enable
- 4 **Reserved (Do Not Program) ..... default = 0**
- 3 **ISA Clock (BCLK) Select Enable**
  - 0 BCLK = PCICLK/4.....default
  - 1 BCLK selected per bits 2-0
- 2-0 **ISA Bus Clock Select (if bit-3 = 1)**
  - 000 BCLK = PCICLK/3.....default
  - 001 BCLK = PCICLK/2
  - 010 BCLK = PCICLK/4
  - 011 BCLK = PCICLK/6
  - 100 BCLK = PCICLK/5
  - 101 BCLK = PCICLK/10
  - 110 BCLK = PCICLK/12
  - 111 BCLK = OSC

Note: Procedure for ISA Clock switching:

1) Set bit 3 to 0; 2) Change value of bit 2-0; 3) Set bit 3 to 1

**Offset 43 - ROM Decode Control..... RW**

Setting these bits enables the indicated address range to be included in the ROMCS# decode:

- 7 **FFFE0000h-FFFEFFFFh ..... default=0**
- 6 **FFF80000h-FFFDFFFFh ..... default=0**
- 5 **FFF00000h-FFF7FFFFh..... default=0**
- 4 **000E0000h-000EFFFFh ..... default=0**
- 3 **000D8000h-000DFFFFh ..... default=0**
- 2 **000D0000h-000D7FFFh ..... default=0**
- 1 **000C8000h-000CFFFFh ..... default=0**
- 0 **000C0000h-000C7FFFh..... default=0**

**Offset 44 - Keyboard Controller Control ..... RW**

- 7 **KBC Timeout Test (do not program)..... default = 0**
- 6-4 **Reserved (do not program) ..... default = 0**
- 3 **Mouse Lock Enable**
  - 0 Disable..... default
  - 1 Enable
- 2-1 **Reserved (do not program) ..... default = 0**
- 0 **Reserved (no function) ..... default = 0**

**Offset 45 - Type F DMA Control ..... RW**

- 7 **ISA Master / DMA to PCI Line Buffer**
  - 0 Disable..... default
  - 1 Enable
- 6 **DMA type F Timing on Channel 7..... default=0**
- 5 **DMA type F Timing on Channel 6..... default=0**
- 4 **DMA type F Timing on Channel 5..... default=0**
- 3 **DMA type F Timing on Channel 3..... default=0**
- 2 **DMA type F Timing on Channel 2..... default=0**
- 1 **DMA type F Timing on Channel 1..... default=0**
- 0 **DMA type F Timing on Channel 0..... default=0**



**Offset 46 - Miscellaneous Control 1.....RW**

- 7 PCI Master Write Wait States**
  - 0 0 Wait States .....default
  - 1 1 Wait State
- 6 Gate INTR**
  - 0 Disable .....default
  - 1 Enable
- 5 Flush Line Buffer for Int or DMA IOR Cycle**
  - 0 Disable .....default
  - 1 Enable
- 4 Config Command Reg Rx04 Access (Test Only)**
  - 0 Normal: Bits 0-1=RO, Bit 3=RW.....default
  - 1 Test Mode: Bits 0-1=RW, Bit-3=RO
- 3 Reserved** (do not program)..... default = 0
- 2 Reserved** (no function)..... default = 0
- 1 PCI Burst Read Interruptability**
  - 0 Allow burst reads to be interrupted by ISA master or DMA.....default
  - 1 Don't allow PCI burst reads to be interrupted
- 0 Posted Memory Write Enable**
  - 0 Disable .....default
  - 1 Enable

The Posted Memory Write function is automatically enabled when Delay Transaction (see Rx47 bit-6) is enabled, independent of the state of this bit.

**Offset 47 - Miscellaneous Control 2 ..... RW**

- 7 CPU Reset Source**
  - 0 Use CPURST as CPU Reset ..... default
  - 1 Use INIT as CPU Reset
- 6 PCI Delay Transaction Enable**
  - 0 Disable..... default
  - 1 Enable

The "Posted Memory Write" function is automatically enabled when this bit is enabled, independent of the state of Rx46 bit-0.
- 5 EISA 4D0/4D1 Port Enable**
  - 0 Disable (ignore ports 4D0-1)..... default
  - 1 Enable (ports 4D0-1 per EISA specification)
- 4 Interrupt Controller Shadow Register Enable**
  - 0 Disable..... default
  - 1 Enable (for test purposes, enable readback of interrupt controller internal functions on I/O reads from ports 20-21, A0-A1, A8-A9, and C8-C9) (Contact VIA Test Engineering department)
- 3 Reserved (always program to 0)..... default = 0**  
 Note: Always mask this bit. This bit may read back as either 0 or 1 but must always be programmed with 0.
- 2 Write Delay Transaction Time-Out Timer**
  - 0 Disable..... default
  - 1 Enable
- 1 Read Delay Transaction Time-Out Timer**
  - 0 Disable..... default
  - 1 Enable
- 0 Software PCI Reset .....** write 1 to generate PCI reset

**Offset 48 - Miscellaneous Control 3.....RW**

- 7-4 **Reserved** ..... always reads 0
- 3 **Extra RTC Port 74/75 Enable**
  - 0 Disable .....default
  - 1 Enable
- 2 **Integrated USB Controller Disable**
  - 0 Enable.....default
  - 1 Disable
- 1 **Integrated IDE Controller Disable**
  - 0 Enable.....default
  - 1 Disable
- 0 **512K PCI Memory Decode**
  - 0 Use Rx4E[15-12] to select top of PCI memory
  - 1 Use contents of Rx4E[15-12] plus 512K as top of PCI memory .....default

**Offset 4A - IDE Interrupt Routing .....RW**

- 7 **Wait for PGNT Before Grant to ISA Master / DMA**
  - 0 Disable .....default
  - 1 Enable
- 6 **Bus Select for Access to I/O Devices Below 100h**
  - 0 Access ports 00-FFh via XD bus.....default
  - 1 Access ports 00-FFh via SD bus (applies to external devices only; internal devices such as the mouse controller are not effected)
- 5-4 **Reserved (do not program)** ..... default = 0
- 3-2 **IDE Second Channel IRQ Routing**
  - 00 IRQ14
  - 01 IRQ15.....default
  - 10 IRQ10
  - 11 IRQ11
- 1-0 **IDE Primary Channel IRQ Routing**
  - 00 IRQ14.....default
  - 01 IRQ15
  - 10 IRQ10
  - 11 IRQ11

**4C - ISA DMA/Master Memory Access Control 1 ..... RW**

- 7-0 **PCI Memory Hole Bottom Address**  
These bits correspond to HA[23:16] .....default=0

**4D - ISA DMA/Master Memory Access Control 2 ..... RW**

- 7-0 **PCI Memory Hole Top Address (HA[23:16])**  
These bits correspond to HA[23:16] .....default=0

Note: Access to the memory defined in the PCI memory hole will not be forwarded to PCI. This function is disabled if the top address is less than or equal to the bottom address.

**4F-4E - ISA DMA/Master Memory Access Control 3... RW**

- 15-12 **Top of PCI Memory** for ISA DMA/Master accesses
  - 0000 1M ..... default
  - 0001 2M
  - ... ..
  - 1111 16M

Note: All ISA DMA / Masters that access addresses higher than the top of PCI memory will not be directed to the PCI bus.

- 11 **Forward E0000-EFFFF Accesses to PCI**.....def=0
- 10 **Forward A0000-BFFFF Accesses to PCI** .....def=0
- 9 **Forward 80000-9FFFF Accesses to PCI** .....def=1
- 8 **Forward 00000-7FFFF Accesses to PCI** .....def=1
- 7 **Forward DC000-DFFFF Accesses to PCI** .....def=0
- 6 **Forward D8000-DBFFF Accesses to PCI** .....def=0
- 5 **Forward D4000-D7FFF Accesses to PCI** .....def=0
- 4 **Forward D0000-D3FFF Accesses to PCI** .....def=0
- 3 **Forward CC000-CFFFF Accesses to PCI** .....def=0
- 2 **Forward C8000-CBFFF Accesses to PCI** .....def=0
- 1 **Forward C4000-C7FFF Accesses to PCI** .....def=0
- 0 **Forward C0000-C3FFF Accesses to PCI** .....def=0

## **Plug and Play Control**

### **Offset 50 – PNP DMA Request Control.....RW**

7-4 **Reserved** ..... default = 0  
 3-2 **PnP Routing for Parallel Port DRQ**.....def = DRQ3  
 1-0 **PnP Routing for Floppy DRQ**.....def = DRQ2  
 DRQ Mapping: 00=DRQ0, 01=DRQ1, 10=DRQ2, 11=DRQ3

### **Offset 51 - PNP IRQ Routing 1.....RW**

7-4 **PnP Routing for Parallel Port IRQ** (see PnP IRQ routing table)  
 3-0 **PnP Routing for Floppy IRQ** (see PnP IRQ routing table)

### **Offset 52 - PNP IRQ Routing 2.....RW**

7-4 **PnP Routing for Serial Port 2 IRQ** (see PnP IRQ routing table)  
 3-0 **PnP Routing for Serial Port 1 IRQ** (see PnP IRQ routing table)

### **Offset 54 - PCI IRQ Edge / Level Select.....RW**

7-4 **Reserved** ..... always reads 0  
 The following bits all default to “level” triggered (0)  
 3 **PIRQA# Invert (edge) / Non-invert (level)**.....(1/0)  
 2 **PIRQB# Invert (edge) / Non-invert (level)**.....(1/0)  
 1 **PIRQC# Invert (edge) / Non-invert (level)**.....(1/0)  
 0 **PIRQD# Invert (edge) / Non-invert (level)**.....(1/0)

Note: PIRQA-D# normally connect to PCI interrupt pins INTA-D# (see pin definitions for more information).

### **Offset 55 - PNP IRQ Routing 4.....RW**

7-4 **PIRQA# Routing** (see PnP IRQ routing table)  
 3-0 **Reserved** ..... always reads 0

### **Offset 56 - PNP IRQ Routing 5.....RW**

7-4 **PIRQC# Routing** (see PnP IRQ routing table)  
 3-0 **PIRQB# Routing** (see PnP IRQ routing table)

### **Offset 57 - PNP IRQ Routing 6.....RW**

7-4 **PIRQD# Routing** (see PnP IRQ routing table)  
 3-0 **Reserved** ..... always reads 0

### **PnP IRQ Routing Table**

0000 Disabled..... default  
 0001 IRQ1  
 0010 Reserved  
 0011 IRQ3  
 0100 IRQ4  
 0101 IRQ5  
 0110 IRQ6  
 0111 IRQ7  
 1000 Reserved  
 1001 IRQ9  
 1010 IRQ10  
 1011 IRQ11  
 1100 IRQ12  
 1101 Reserved  
 1110 IRQ14  
 1111 IRQ15

**Offset 59 – PCS0# Control .....RW**

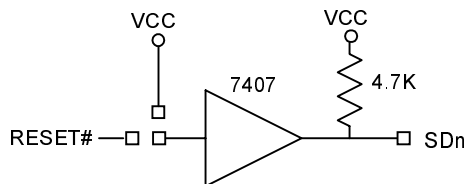
- 7-4 **Reserved** ..... always reads 0
- 3 **PCS0# Pin Function (Pin T5)**
  - 0 Pin is defined as PCS0# .....default
  - 1 Pin is defined as Internal Trap I/O
- 2-0 **Reserved** ..... always reads 0

**Offset 5A – KBC / RTC Control.....RW**

Bits 7-4 of this register are latched from pins SD7-4 at power-up but are read/write accessible so may be changed after power-up to change the default strap setting:

- 7 **Keyboard RP16** ..... latched from SD7
- 6 **Keyboard RP15** ..... latched from SD6
- 5 **Keyboard RP14** ..... latched from SD5
- 4 **Keyboard RP13** ..... latched from SD4
- 3 **Audio Function Enable**
  - ..... RO, strapped from SPKR pin V5
  - 0 Disable (SDD pins function as SDD)
  - 1 Enable (SDD pins function as Audio / Game)
- 2 **Internal RTC Enable**
  - 0 Disable
  - 1 Enable .....default
- 1 **Internal PS2 Mouse Enable**
  - 0 Disable .....default
  - 1 Enable
- 0 **Internal KBC Enable**
  - 0 Disable .....default
  - 1 Enable

Note: External strap option values may be set by connecting the indicated external pin to a 4.7K ohm pullup (for 1) or driving it low during reset with a 7407 TTL open collector buffer (for 0) as shown in the suggested circuit below:



**Figure 5. Strap Option Circuit**

**Offset 5B - Internal RTC Test Mode ..... RW**

- 7-4 **Reserved** .....always reads 0
- 3 **Map RTC Rx32 to Rx3F**
  - 0 Disable..... default
  - 1 Enable
- 2 **RTC Reset Enable** (do not program)
  - 0 Disable..... default
  - 1 Enable
- 1 **RTC SRAM Access Enable**
  - 0 Disable..... default
  - 1 Enable

This bit is set if the internal RTC is disabled but it is desired to still be able to access the internal RTC SRAM via ports 74-75. If the internal RTC is enabled, setting this bit does nothing (the internal RTC SRAM should be accessed at either ports 70/71 or 72/73).
- 0 **RTC Test Mode Enable** (do not program) .default=0

**Offset 5C - DMA Control..... RW**

- 7 **PCS0# & PCS1# 16-Bit I/O**
  - 0 Disable..... default
  - 1 Enable
- 6 **Passive Release**
  - 0 Disable..... default
  - 1 Enable
- 5 **Internal Passive Release**
  - 0 Disable..... default
  - 1 Enable
- 4 **Dummy PREQ**
  - 0 Disable..... default
  - 1 Enable
- 3 **Reserved** .....always reads 0
- 2 **APIC Connection**
  - 0 APIC on SD Bus..... default
  - 1 APIC on XD Bus
- 1 **Reserved (Do Not Program)** ..... default = 0
- 0 **DMA Line Buffer Disable**
  - 0 DMA cycles can be to/from line buffer .....def
  - 1 Disable DMA Line Buffer

## Distributed DMA / Serial IRQ Control

### Offset 61-60 - Distributed DMA Ch 0 Base / Enable.....RW

- 15-4 Channel 0 Base Address Bits 15-4 ..... default = 0
- 3 Channel 0 Enable
  - 0 Disable .....default
  - 1 Enable
- 2-0 Reserved ..... always reads 0

### Offset 63-62 - Distributed DMA Ch 1 Base / Enable.....RW

- 15-4 Channel 1 Base Address Bits 15-4 ..... default = 0
- 3 Channel 1 Enable
  - 0 Disable .....default
  - 1 Enable
- 2-0 Reserved ..... always reads 0

### Offset 65-64 - Distributed DMA Ch 2 Base / Enable.....RW

- 15-4 Channel 2 Base Address Bits 15-4 ..... default = 0
- 3 Channel 2 Enable
  - 0 Disable .....default
  - 1 Enable
- 2-0 Reserved ..... always reads 0

### Offset 67-66 - Distributed DMA Ch 3 Base / Enable.....RW

- 15-4 Channel 3 Base Address Bits 15-4 ..... default = 0
- 3 Channel 3 Enable
  - 0 Disable .....default
  - 1 Enable
- 2-0 Reserved ..... always reads 0

### Offset 69-68 – Serial IRQ Control .....RW

- 15-4 Reserved ..... always reads 0
- 3 ISA IRQ Asserted Via Serial IRQ (Pin H3 or L4)
  - 0 Disable .....default
  - 1 Enable
- 2 Serial IRQ Mode
  - 0 Continuous Mode .....default
  - 1 Quiet Mode
- 1-0 Serial IRQ Start-Frame Width
  - 00 4 PCI Clocks .....default
  - 01 6 PCI Clocks
  - 10 8 PCI Clocks
  - 11 10 PCI Clocks

The frame size is fixed at 21 PCI clocks.

### Offset 6B-6A - Distributed DMA Ch 5 Base / Enable.... RW

- 15-4 Channel 5 Base Address Bits 15-4..... default = 0
- 3 Channel 5 Enable
  - 0 Disable ..... default
  - 1 Enable
- 2-0 Reserved .....always reads 0

### Offset 6D-6C - Distributed DMA Ch 6 Base / Enable ... RW

- 15-4 Channel 6 Base Address Bits 15-4..... default = 0
- 3 Channel 6 Enable
  - 0 Disable ..... default
  - 1 Enable
- 2-0 Reserved .....always reads 0

### Offset 6F-6E - Distributed DMA Ch 7 Base / Enable .... RW

- 15-4 Channel 7 Base Address Bits 15-4..... default = 0
- 3 Channel 7 Enable
  - 0 Disable ..... default
  - 1 Enable
- 2-0 Reserved .....always reads 0

**Miscellaneous / General Purpose I/O**
**Offset 73-70 - Subsystem ID ..... WO**

**31-0 Subsystem ID / Vendor ID**..... always reads 0  
 Contents may be read at offset 2C.

**Offset 74 – GPIO Control 1.....RW**

- 7 APIC Enable**
  - 0 Disable (Pin U8 is GPIOD / MCCS#)....default
  - 1 Enable (Pin U8 is SCIOUT#)
- 6 SERIRQ Pin**
  - 0 SERIRQ input from DRQ2 (Pin H3).....default
  - 1 SERIRQ input from DACK5# (Pin L4)
- 5 GPIOD Direction (Pin U8)**
  - 0 Input .....default
  - 1 Output (GPO11)
- 4 GPIOC Direction (Pin V14)**
  - 0 Input .....default
  - 1 Output
- 3 GPIOB Direction (Pin U12)**
  - 0 Input .....default
  - 1 Output
- 2 GPIOA Direction (Pin T14)**
  - 0 Input .....default
  - 1 Output
- 1 THRM Enable (Pin T11)**
  - 0 PME# / GPI5 (see Func 4 Rx48[5]).....default
  - 1 THRM
- 0 GPIO / IOCHCK# Select**
  - 0 GPIO .....default
  - 1 IOCHCK#

**Offset 75 – GPIO Control 2..... RW**

- 7 GPO7 Enable (Pin T7)**
  - 0 Pin defined as SLP#..... default
  - 1 Pin defined as GPO7
- 6 Reserved** .....always reads 0
- 5 GPO5 Enable (Pin V12)**
  - 0 Pin defined as PCISTP# ..... default
  - 1 Pin defined as GPO5
- 4 GPO4 Enable (Pin Y12)**
  - 0 Pin defined as CPUTSTP#..... default
  - 1 Pin defined as GPO4
- 3 FDC External IRQ / DRQ Via DACK2# / DRQ2**
  - 0 Pin G5 is FDCIRQ, pin H3 is FDCDRQ ..... def
  - 1 Pin G5 is DACK2# or other alternate function  
 Pin H3 is DRQ2 or other alternate function
- 2 GPO25 Enable (Pin G5)**
  - 0 Rx75[3]=0: Pin G5 defined as DACK2#.... def
  - 1 Pin G5 defined as GPO25
- 1 GPO24 Enable (Pin H3)**
  - 0 Rx75[3]=0: ..... default  
 Rx68[3]=0: Pin H3 defined as DRQ2  
 Rx68[3]=1: Pin H3 defined as SERIRQ
  - 1 Pin H3 defined as GPO24
- 0 Positive Decode**
  - 0 Subtractive Decode..... default
  - 1 Positive Decode

**Offset 76 – GPIO Control 3.....RW**

- 7 Over-Current (OC) Input**
  - 0 Disable .....default
  - 1 Enable
- 6 OC[3:0] From SD[3:0] By Scan**
  - 0 Disable .....default
  - 1 Enable
- 5 GPO14 / GPO15 Enable (Pins E12 / D12)**
  - 0 Pins used for IRTX and IRRX .....default
  - 1 Pins used for GPO14 and GPO15
- 4 MCCS# Pin Select**
  - 0 MCCS# is on Pin U5 .....default
  - 1 MCCS# is on Pin U8
- 3 MCCS# Function**
  - 0 Disable MCCS# function on U5/U8.....default
  - 1 Enable MCCS# function on U5/U8  
(see bit-4 for select of U5 or U8 for MCCS#)
- 2 CHAS Enable (Pin V14)**
  - 0 Pin is defined as GPIOC.....default
  - 1 Pin is defined as CHAS
- 1 GPO12 Enable (Pin T5)**
  - 0 Pin is defined as XDIR.....default
  - 1 Pin is defined as GPO12
- 0 GPOWE# (GPO[23-16]) Enable (Pin T14)**
  - 0 Pin is defined as GPIOA .....default
  - 1 Pin is defined as GPOWE# (Rx74[2] also must be set to 1)

**Offset 77 – GPIO Control 4 Control.....RW**

- 7 DRQ / DACK# Pins are GPI / GPO**
  - 0 Disable .....default
  - 1 Enable
- 6 Game Port XY Pins are GPI / GPO**
  - 0 Disable .....default
  - 1 Enable
- 5-4 Reserved** ..... always reads 0
- 3 SERIRQ SMI Slot**
  - 0 Disable .....default
  - 1 Enable
- 2 RTC Rx32 Write Protect**
  - 0 Disable .....default
  - 1 Enable
- 1 RTC Rx0D Write Protect**
  - 0 Disable .....default
  - 1 Enable
- 0 GPO13 Enable (Pin U5)**
  - 0 Pin defined as SOE#.....default
  - 1 Pin defined as GPO13

**Offset 79-78 – PCS0# I/O Port Address..... RW**

15-0 PCS0# I/O Port Address [15-0]

**Offset 7B-7A – PCS1# I/O Port Address ..... RW**

15-0 PCS1# I/O Port Address [15-0]

**Offset 7D-7C – PCI DMA Channel Enable ..... RW**

- 15-9 Reserved** .....always reads 0
- 8 PCI DMA Pair A**
  - 0 Disable..... default
  - 1 Enable
- 7 PCI DMA Channel 7**
  - 0 Disable..... default
  - 1 Enable
- 6 PCI DMA Channel 6**
  - 0 Disable..... default
  - 1 Enable
- 5 PCI DMA Channel 5**
  - 0 Disable..... default
  - 1 Enable
- 4 Reserved** .....always reads 0
- 3 PCI DMA Channel 3**
  - 0 Disable..... default
  - 1 Enable
- 2 PCI DMA Channel 2**
  - 0 Disable..... default
  - 1 Enable
- 1 PCI DMA Channel 1**
  - 0 Disable..... default
  - 1 Enable
- 0 PCI DMA Channel 0**
  - 0 Disable..... default
  - 1 Enable

**Offset 7F-7E – 32-Bit DMA Control..... RW**

- 15-3 32-Bit DMA High Page (A31-24) Registers IOBase**
- 2-1 Reserved** .....always reads 0
- 0 32-Bit DMA**
  - 0 Disable..... default
  - 1 Enable

**Offset 80 – Programmable Chip Select Mask ..... RW**

- 7-4 PCS1# I/O Port Address Mask [3-0]**
- 3-0 PCS0# I/O Port Address Mask [3-0]**

**Offset 81 – ISA Positive Decoding Control 1 .....RW**

- 7 On-Board I/O Port Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 6 Microsoft-Sound System I/O Port Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 5-4 Microsoft-Sound System I/O Decode Range**
  - 00 0530h-0537h .....default
  - 01 0604h-060Bh
  - 10 0E80-0E87h
  - 11 0F40h-0F47h
- 3 APIC Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 2 BIOS ROM Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 1 Reserved** ..... always reads 0
- 0 PCS0 Positive Decoding**
  - 0 Disable .....default
  - 1 Enable

**Offset 82 – ISA Positive Decoding Control 2 .....RW**

- 7 FDC Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 6 LPT Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 5-4 LPT Decode Range**
  - 00 3BCh-3BFh, 7BCh-7BEh.....default
  - 01 378h-37Fh, 778h-77Ah
  - 10 278h-27Fh, 678h-67Ah
  - 11 -reserved-
- 3 Game Port Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 2 MIDI Positive Decoding**
  - 0 Disable .....default
  - 1 Enable
- 1-0 MIDI Decode Range**
  - 00 300h-303h .....default
  - 01 310h-313h
  - 10 320h-323h
  - 11 330h-333h

**Offset 83 – ISA Positive Decoding Control 3..... RW**

- 7 COM Port B Positive Decoding**
  - 0 Disable..... default
  - 1 Enable
- 6-4 COM-Port B Decode Range**
  - 000 3F8h-3FFh (COM1)..... default
  - 001 2F8h-2FFh (COM2)
  - 010 220h-227h
  - 011 228h-22Fh
  - 100 238h-23Fh
  - 101 2E8h-2EFh (COM4)
  - 110 338h-33Fh
  - 111 3E8h-3EFh (COM3)
- 3 COM Port A Positive Decoding**
  - 0 Disable..... default
  - 1 Enable
- 2-0 COM-Port A Decode Range**
  - 000 3F8h-3FFh (COM1)..... default
  - 001 2F8h-2FFh (COM2)
  - 010 220h-227h
  - 011 228h-22Fh
  - 100 238h-23Fh
  - 101 2E8h-2EFh (COM4)
  - 110 338h-33Fh
  - 111 3E8h-3EFh (COM3)

**Offset 84 – ISA Positive Decoding Control 4..... RW**

- 7-4 Reserved** .....always reads 0
- 3 FDC Decoding Range**
  - 0 Primary ..... default
  - 1 Secondary
- 2 Sound Blaster Positive Decoding**
  - 0 Disable..... default
  - 1 Enable
- 1-0 Sound Blaster Decode Range**
  - 00 220h-22Fh, 230h-233h ..... default
  - 01 240h-24Fh, 250h-253h
  - 10 260h-26Fh, 270h-273h
  - 11 280h-28Fh, 290h-293h



**Offset 85 – Extended Function Enable .....RW**

- 7-5 **Reserved** ..... always reads 0
- 4 **Function 3 USB Ports 2-3**
  - 0 Enable.....default
  - 1 Disable
- 3 **Function 6 Modem / Audio**
  - 0 Enable.....default
  - 1 Disable
- 2 **Function 5 Audio**
  - 0 Enable.....default
  - 1 Disable
- 1 **Super-I/O Configuration**
  - 0 Disable .....default
  - 1 Enable
- 0 **Super-I/O**
  - 0 Disable .....default
  - 1 Enable

**Offset 86 – PNP IRQ/DRQ Test 1 (Do Not Program) ... RW**

**Offset 87 – PNP IRQ/DRQ Test 2 (Do Not Program) ... RW**

**Offset 88 – PLL Test .....RW**

- 7 PCS0# Access Status
- 6 RTC Rx32 / Rx7F Write Protect
  - 0 Disable .....default
  - 1 Enable
- 5 MC IRQ Test (Do Not Program)
  - 0 Disable .....default
  - 1 Enable
- 4 PLL PU (Do Not Program)
  - 0 Disable .....default
  - 1 Enable
- 3 PLL Test Mode (Do Not Program)
  - 0 Disable .....default
  - 1 Enable
- 2-0 PLL Test Mode Select

**Offset 89 – PLL Control .....RW**

- 7-4 Reserved ..... always reads 0
- 3-2 PLL PCLK Input Delay Select
- 1-0 PLL CLK66 Feedback Delay Select

**Offset 8A – PCS2/3 I/O Port Address Mask..... RW**

- 7-4 PCS3# I/O Port Address Mask 3-0
- 3-0 PCS2# I/O Port Address Mask 3-0

**Offset 8B – PCS Control ..... RW**

- 7 PCS3# For Internal I/O
  - 0 Disable..... default
  - 1 Enable
- 6 PCS2# For Internal I/O
  - 0 Disable..... default
  - 1 Enable
- 5 PCS1# For Internal I/O
  - 0 Disable..... default
  - 1 Enable
- 4 PCS0# For Internal I/O
  - 0 Disable..... default
  - 1 Enable
- 3 PCS3#
  - 0 Disable..... default
  - 1 Enable
- 2 PCS2#
  - 0 Disable..... default
  - 1 Enable
- 1 PCS1#
  - 0 Disable..... default
  - 1 Enable
- 0 PCS0#
  - 0 Disable..... default
  - 1 Enable

**Offset 8D-8C – PCS2# I/O Port Address..... RW**

- 15-0 PCS2# I/O Port Address

**Offset 8F-8E – PCS3# I/O Port Address..... RW**

- 15-0 PCS3# I/O Port Address

## **Function 1 Registers - Enhanced IDE Controller**

This Enhanced IDE controller interface is fully compatible with the SFF 8038i v.1.0 specification. There are two sets of software accessible registers -- PCI configuration registers and Bus Master IDE I/O registers. The PCI configuration registers are located in the function 1 PCI configuration space of the VT8231. The Bus Master IDE I/O registers are defined in the SFF8038i v1.0 specification.

### **PCI Configuration Space Header**

#### **Offset 1-0 - Vendor ID (1106h=VIA).....RO**

#### **Offset 3-2 - Device ID (0571h=IDE Controller).....RO**

#### **Offset 5-4 - Command.....RW**

- 15-10 **Reserved** ..... always reads 0
- 9 **Fast Back to Back Cycles** ..... default = 0 (disabled)
- 8 **SERR# Enable** ..... default = 0 (disabled)
- 7 **Address Stepping** ..... **fixed at 1 (enabled)**  
A value of 1 provides additional address decode time to IDE devices.
- 6 **Parity Error Response** ..... default = 0 (disabled)
- 5 **VGA Palette Snoop** ..... fixed at 0 (disabled)
- 4 **Memory Write & Invalidate** ..... fixed at 0 (disabled)
- 3 **Special Cycles** ..... fixed at 0 (disabled)
- 2 **Bus Master** ..... default = 0 (disabled)  
S/G operation can be issued only when the "Bus Master" bit is enabled.
- 1 **Memory Space** ..... fixed at 0 (disabled)
- 0 **I/O Space** ..... default = 0 (disabled)  
When the "I/O Space" bit is disabled, the device will not respond to any I/O addresses for both compatible and native mode.

#### **Offset 7-6 - Status.....RO**

- 15 **Detected Parity Error** ..... fixed at 0
- 14 **Signalled System Error** ..... fixed at 0
- 13 **Received Master Abort** ..... fixed at 0
- 12 **Received Target Abort** ..... fixed at 0
- 11 **Signalled Target Abort** ..... fixed at 0
- 10-9 **DEVSEL# Timing** ..... default = 01 (medium)
- 8 **Data Parity Detected** ..... fixed at 0
- 7 **Fast Back to Back** ..... fixed at 1
- 6-0 **Reserved** ..... always reads 0

#### **Offset 8 - Revision ID (06) .....RO**

- 0-7 **Revision Code for IDE Controller Logic Block**

#### **Offset 9 - Programming Interface ..... RW**

- 7 **Master IDE Capability** ..... fixed at 1 (Supported)
- 6-4 **Reserved** ..... always reads 0
- 3 **Programmable Indicator - Secondary** ..... fixed at 1  
Supports both modes (may be set to either mode by writing bit-2)
- 2 **Reserved** ..... always reads 0
- 1 **Programmable Indicator - Primary** ..... fixed at 1  
Supports both modes (may be set to either mode by writing bit-0)
- 0 **Reserved** ..... always reads 0

#### **Compatibility Mode (fixed IRQs and I/O addresses):**

| <u>Channel</u> | <u>Command Block</u> | <u>Control Block</u> | <u>IRQ</u> |
|----------------|----------------------|----------------------|------------|
|                | <u>Registers</u>     | <u>Registers</u>     |            |
| Pri            | 1F0-1F7              | 3F6                  | 14         |
| Sec            | 170-177              | 376                  | 15         |

#### **Native PCI Mode (registers are programmable in I/O space)**

| <u>Channel</u> | <u>Command Block</u> | <u>Control Block</u> |
|----------------|----------------------|----------------------|
|                | <u>Registers</u>     | <u>Registers</u>     |
| Pri            | BA @offset 10h       | BA @offset 14h       |
| Sec            | BA @offset 18h       | BA @offset 1Ch       |

Command register blocks are 8 bytes of I/O space

Control registers are 4 bytes of I/O space (only byte 2 is used)

#### **Offset A - Sub Class Code (01h=IDE Controller) ..... RO**

#### **Offset B - Base Class Code (01h=Mass Storage Ctrlr)... RO**

#### **Offset C - Cache Line Size (00h)..... RO**

#### **Offset D - Latency Timer (Default=0)..... RW**

#### **Offset E - Header Type (00h)..... RO**

#### **Offset F - BIST (00h) ..... RO**

**Offset 13-10 - Pri Data / Command Base Address.....RW**

Specifies an 8 byte I/O address space.

- 31-16 **Reserved** .....always read 0
- 15-3 **Port Address** ..... default=01F0h
- 2-0 **Fixed at 001b** ..... fixed

**Offset 17-14 - Pri Control / Status Base Address.....RW**

Specifies a 4 byte I/O address space of which only the third byte is active (i.e., 3F6h for the default base address of 3F4h).

- 31-16 **Reserved** .....always read 0
- 15-2 **Port Address** ..... default=03F4h
- 1-0 **Fixed at 01b** ..... fixed

**Offset 1B-18 - Sec Data / Command Base Address .....RW**

Specifies an 8 byte I/O address space.

- 31-16 **Reserved** .....always read 0
- 15-3 **Port Address** ..... default=0170h
- 2-0 **Fixed at 001b** ..... fixed

**Offset 1F-1C - Sec Control / Status Base Address.....RW**

Specifies a 4 byte I/O address space of which only the third byte is active (i.e., 376h for the default base address of 374h).

- 31-16 **Reserved** .....always read 0
- 15-2 **Port Address** ..... default=0374h
- 1-0 **Fixed at 01b** ..... fixed

**Offset 23-20 - Bus Master Control Regs Base Address..RW**

Specifies a 16 byte I/O address space compliant with the SFF-8038i rev 1.0 specification.

- 31-16 **Reserved** .....always read 0
- 15-4 **Port Address** ..... default=CC0h
- 3-0 **Fixed at 0001b** ..... fixed

**Offset 34 - Capability Pointer (C0h) ..... RO**
**Offset 3C - Interrupt Line (0Eh) ..... RO**
**Offset 3D - Interrupt Pin (00h)..... RO**
**7-0 Interrupt Routing Mode**

- 00h Legacy mode interrupt routing..... default
- 01h Native mode interrupt routing

**Offset 3E - Min Gnt (00h) ..... RO**
**Offset 3F - Max Latency (00h)..... RO**

**IDE-Controller-Specific Configuration Registers**
**Offset 40 - Chip Enable.....RW**

- 7-4 **Reserved** ..... always reads 0  
 3-2 **Reserved (Do Not Program)**..... R/W, default = 0  
     1 **Primary Channel Enable**..... default = 0 (disabled)  
     0 **Secondary Channel Enable** .... default = 0 (disabled)

**Offset 41 - IDE Configuration.....RW**

- 7 **Primary IDE Read Prefetch Buffer**  
     0 Disable .....default  
     1 Enable  
 6 **Primary IDE Post Write Buffer**  
     0 Disable .....default  
     1 Enable  
 5 **Secondary IDE Read Prefetch Buffer**  
     0 Disable .....default  
     1 Enable  
 4 **Secondary IDE Post Write Buffer**  
     0 Disable .....default  
     1 Enable  
  
 3 **Reserved** ..... always reads 0  
  
 2 **Reserved (Do Not Change)**..... default=1  
 1 **Reserved (Do Not Change)**..... default=1  
  
 0 **Reserved** ..... always reads 0

**Offset 42 - Reserved (Do Not Program) .....RW**
**Offset 43 - FIFO Configuration..... RW**

- 7-4 **Reserved** ..... always reads 0  
 3-2 **Threshold for Primary Channel**  
     00 0  
     01 1/4  
     10 1/2 ..... default  
     11 3/4  
 1-0 **Threshold for Secondary Channel**  
     00 0  
     01 1/4  
     10 1/2 ..... default  
     11 3/4

**Offset 44 - Miscellaneous Control 1.....RW**

- 7 **Reserved** ..... always reads 0
- 6 **Master Read Cycle IRDY# Wait States**
  - 0 0 wait states
  - 1 1 wait state.....default
- 5 **Master Write Cycle IRDY# Wait States**
  - 0 0 wait states
  - 1 1 wait state.....default
- 4 **Reserved** ..... always reads 0
- 3 **Bus Master IDE Status Register Read Retry**
  - Retry bus master IDE status register read when master write operation for DMA read is not complete
  - 0 Disabled
  - 1 Enabled.....default
- 2-1 **Reserved** ..... always reads 0
- 0 **UltraDMA Host Must Wait for First Strobe Before Termination**
  - 0 Enabled.....default
  - 1 Disabled

**Offset 45 - Miscellaneous Control 2.....RW**

- 7 **Reserved** ..... always reads 0
- 6 **Interrupt Steering Swap**
  - 0 Don't swap channel interrupts.....default
  - 1 Swap interrupts between the two channels
- 5-4 **Reserved** ..... always reads 0
- 3 **Memory Read Multiple Command**
  - 0 Disable .....default
  - 1 Enable
- 2 **Memory Read and Invalidate Command**
  - 0 Disable .....default
  - 1 Enable
- 1 **Secondary Channel Threshold Enable**
  - 0 Disable (data transfer starts immediately if FIFO is not empty)
  - 1 Enable (data transfer will not start until the FIFO is filled to the threshold set in bits 1-0 of Rx43) .....default
- 0 **Primary Channel Threshold Enable**
  - 0 Disable (data transfer starts immediately if FIFO is not empty)
  - 1 Enable (data transfer will not start until the FIFO is filled to the threshold set in bits 3-2 of Rx43) .....default

**Offset 46 - Miscellaneous Control 3 ..... RW**

- 7 **Primary Channel Read DMA FIFO Flush**
  - 1 = Enable FIFO flush for read DMA when interrupt asserts primary channel. ....default=1 (enabled)
- 6 **Secondary Channel Read DMA FIFO Flush**
  - 1 = Enable FIFO flush for Read DMA when interrupt asserts secondary channel. .... Default=1 (enabled)
- 5 **Primary Channel End-of-Sector FIFO Flush**
  - 1 = Enable FIFO flush at the end of each sector for the primary channel. .... Default=0 (disabled)
- 4 **Secondary Channel End-of-Sector FIFO Flush**
  - 1 = Enable FIFO flush at the end of each sector for the secondary channel..... Default=0 (disabled)
- 3-2 **Reserved** .....always reads 0
- 1-0 **Max DRDY Pulse Width**
  - Maximum DRDY# pulse width after the cycle count. Command will deassert in spite of DRDY# status to avoid system ready hang.
  - 00 No limitation..... default
  - 01 64 PCI clocks
  - 10 128 PCI clocks
  - 11 192 PCI clocks

**Offset 4B-48 - Drive Timing Control.....RW**

The following fields define the Active Pulse Width and Recovery Time for the IDE DIOR# and DIOW# signals:

- 31-28 **Primary Drive 0 Active Pulse Width**..... def=1010b
- 27-24 **Primary Drive 0 Recovery Time**..... def=1000b
- 23-20 **Primary Drive 1 Active Pulse Width**..... def=1010b
- 19-16 **Primary Drive 1 Recovery Time**..... def=1000b
- 15-12 **Secondary Drive 0 Active Pulse Width**.. def=1010b
- 11-8 **Secondary Drive 0 Recovery Time** ..... def=1000b
- 7-4 **Secondary Drive 1 Active Pulse Width**.. def=1010b
- 3-0 **Secondary Drive 1 Recovery Time** ..... def=1000b

The actual value for each field is the encoded value in the field plus one and indicates the number of PCI clocks.

**Offset 4C - Address Setup Time.....RW**

- 7-6 **Primary Drive 0 Address Setup Time**
- 5-4 **Primary Drive 1 Address Setup Time**
- 3-2 **Secondary Drive 0 Address Setup Time**
- 1-0 **Secondary Drive 1 Address Setup Time**

For each field above:

- 00 1T
- 01 2T
- 10 3T
- 11 4T .....default

**Offset 4E - Secondary Non-1F0 Port Access Timing.....RW**

- 7-4 **DIOR#/DIOW# Active Pulse Width**..... def=1111b
- 3-0 **DIOR#/DIOW# Recovery Time**..... def=1111b

The actual value for each field is the encoded value in the field plus one and indicates the number of PCI clocks.

**Offset 4F - Primary Non-1F0 Port Access Timing` .....RW**

- 7-4 **DIOR#/DIOW# Active Pulse Width**..... def=1111b
- 3-0 **DIOR#/DIOW# Recovery Time**..... def=1111b

The actual value for each field is the encoded value in the field plus one and indicates the number of PCI clocks.

**Offset 53-50 - UltraDMA Extended Timing Control..... RW**

- 31 **Pri Drive 0 UltraDMA-Mode Enable Method**
  - 0 Enable by using "Set Feature" command..... def
  - 1 Enable by setting bit-30 of this register
- 30 **Pri Drive 0 UltraDMA-Mode Enable**
  - 0 Disable..... default
  - 1 Enable UltraDMA-Mode Operation
- 29 **Pri Drive 0 Transfer Mode**
  - 0 DMA or PIO Mode ..... default
  - 1 UltraDMA Mode
- 28-27 **Reserved** .....always reads 0
- 26-24 **Pri Drive 0 Cycle Time (T = 30nsec @33MHz)**
  - 000 2T
  - 001 3T
  - 010 4T
  - 011 5T
  - 100 6T
  - 101 7T
  - 110 8T
  - 111 9T ..... default
- 23 **Pri Drive 1 UltraDMA-Mode Enable Method**
- 22 **Pri Drive 1 UltraDMA-Mode Enable**
- 21 **Pri Drive 1 Transfer Mode**
- 20 **Reserved** .....always reads 0
- 19 **Pri Clock Source**
  - 0 33 MHz..... default
  - 1 66 MHz
- 18-16 **Pri Drive 1 Cycle Time**
  - 15 **Sec Drive 0 UltraDMA-Mode Enable Method**
  - 14 **Sec Drive 0 UltraDMA-Mode Enable**
  - 13 **Sec Drive 0 Transfer Mode**
  - 12-11 **Reserved** .....always reads 0
  - 10-8 **Sec Drive 0 Cycle Time**
    - 7 **Sec Drive 1 UltraDMA-Mode Enable Method**
    - 6 **Sec Drive 1 UltraDMA-Mode Enable**
    - 5 **Sec Drive 1 Transfer Mode**
    - 4 **Reserved** .....always reads 0
    - 3 **Sec Clock Source**
      - 0 33 MHz..... default
      - 1 66 MHz
    - 2-0 **Sec Drive 1 Cycle Time**

Each byte defines UltraDMA operation for the indicated drive. The bit definitions are the same within each byte.

**Offset 54 – UltraDMA FIFO Control.....RW**

- 7-5 **Reserved** ..... always reads 0
- 4 **One Frame For Each PCI Request For IDE PCI Master Cycles**
  - 0 Disabled .....default
  - 1 Enabled
- 3 **Grant ISA While Sharing Bus with SA & IDE in IDLE State**
  - 0 Enable.....default
  - 1 Disable
- 2 **Change Drive to Clear All FIFO & Internal States**
  - 0 Disabled
  - 1 Enabled.....default
- 1 **Add Dummy FIFO Push After End of Transfer**
  - 0 Enabled
  - 1 Disabled .....default

This bit is normally set to 0 for effective handling of transfer lengths that are not doubleword multiples
- 0 **Complete DMA Cycle with Transfer Size Less Than FIFO Size**
  - 0 Enabled.....default
  - 1 Disabled

**Offset 61-60 - Primary Sector Size ..... RW**

- 15-12 **Reserved** .....always reads 0
- 11-0 **Number of Bytes Per Sector** ...def=200h (512 bytes)

**Offset 69-68 - Secondary Sector Size ..... RW**

- 15-12 **Reserved** .....always reads 0
- 11-0 **Number of Bytes Per Sector** ...def=200h (512 bytes)



**Offset 70 – Primary IDE Status .....RW**

7 Interrupt Status  
 6 Prefetch Buffer Status  
 5 Post Write Buffer Status  
 4 DMA Read Prefetch Status  
 3 DMA Write Prefetch Status  
 2 S/G Operation Complete  
 1-0 Reserved ..... always reads 0

**Offset 71 – Primary Interrupt Control.....RW**

7-1 Reserved ..... always reads 0  
 0 Flush FIFO Before Generating IDE Interrupt  
     0 Disable .....default  
     1 Enable

**Offset 78 – Secondary IDE Status ..... RW**

7 Interrupt Status  
 6 Prefetch Buffer Status  
 5 Post Write Buffer Status  
 4 DMA Read Prefetch Status  
 3 DMA Write Prefetch Status  
 2 S/G Operation Complete  
 1-0 Reserved .....always reads 0

**Offset 79 - Secondary Interrupt Control..... RW**

7-1 Reserved .....always reads 0  
 0 Flush FIFO Before Generating IDE Interrupt  
     0 Disable..... default  
     1 Enable

**Offset 83-80 – Primary S/G Descriptor Address .....RW**

**Offset 8B-88 – Secondary S/G Descriptor Address .....RW**

**Offset C3-C0 – PCI PM Block 1 .....RO**

31-0 PCI PM Block 1..... always reads 0201h

**Offset C7-C4 – PCI PM Block 2 .....RO**

31-2 Reserved ..... always reads 0

1-0 Power State

00 On .....default

01 Off

1x -reserved-

## **IDE I/O Registers**

These registers are compliant with the SFF 8038I v1.0 standard. Refer to the SFF 8038I v1.0 specification for further details.

### **I/O Offset 0 - Primary Channel Command**

### **I/O Offset 2 - Primary Channel Status**

### **I/O Offset 4-7 - Primary Channel PRD Table Address**

### **I/O Offset 8 - Secondary Channel Command**

### **I/O Offset A - Secondary Channel Status**

### **I/O Offset C-F - Secondary Channel PRD Table Address**

## **Function 2 Registers - USB Controller Ports 0-1**

This Universal Serial Bus host controller interface is fully compatible with UHCI specification v1.1. There are two sets of software accessible registers: PCI configuration registers and USB I/O registers. The PCI configuration registers are located in the function 2 PCI configuration space of the VT8231. The USB I/O registers are defined in UHCI specification v1.1. The registers in this function control USB ports 0-1 (see function 3 for ports 2-3).

### **PCI Configuration Space Header**

#### **Offset 1-0 - Vendor ID .....RO**

0-7 Vendor ID ..... (1106h = VIA Technologies)

#### **Offset 3-2 - Device ID.....RO**

0-7 Device ID (3038h = VT8231 USB Controller)

#### **Offset 5-4 - Command.....RW**

15-8 Reserved ..... always reads 0  
 7 Address Stepping ..... default=0 (disabled)  
 6 Reserved (parity error response) .....fixed at 0  
 5 Reserved (VGA palette snoop) .....fixed at 0  
 4 Memory Write and Invalidate . default=0 (disabled)  
 3 Reserved (special cycle monitoring) .....fixed at 0  
 2 Bus Master ..... default=0 (disabled)  
 1 Memory Space ..... default=0 (disabled)  
 0 I/O Space ..... default=0 (disabled)

#### **Offset 7-6 - Status.....RWC**

15 Reserved (detected parity error)..... always reads 0  
 14 Signalled System Error..... default=0  
 13 Received Master Abort..... default=0  
 12 Received Target Abort ..... default=0  
 11 Signalled Target Abort..... default=0  
 10-9 DEVSEL# Timing  
     00 Fast  
     01 Medium .....default (fixed)  
     10 Slow  
     11 Reserved  
 8-0 Reserved ..... always reads 0

#### **Offset 8 - Revision ID (nnh)..... RO**

7-0 Silicon Revision Code (0 indicates first silicon)  
 06h Corresponds to Chip Revision D

#### **Offset 9 - Programming Interface (00h) ..... RO**

#### **Offset A - Sub Class Code (03h=USB Controller) ..... RO**

#### **Offset B - Base Class Code (0Ch=Serial Bus Controller)RO**

#### **Offset C - Cache Line Size (00h)..... RO**

#### **Offset D - Latency Timer ..... RW**

7-0 Timer Value ..... default = 16h

#### **Offset E - Header Type (00h)..... RO**

#### **Offset F - BIST (00h)..... RO**

#### **Offset 23-20 - USB I/O Register Base Address..... RW**

31-16 Reserved .....always reads 0  
 15-5 USB I/O Register Base Address. Port Address for the base of the 32-byte USB I/O Register block, corresponding to AD[15:5]  
 4-0 00001b

#### **Offset 3C - Interrupt Line (00h)..... RW**

7-4 Reserved .....always reads 0  
 3-0 USB Interrupt Routing ..... default = 16h  
     0000 Disabled ..... default  
     0001 IRQ1  
     0010 Reserved  
     0011 IRQ3  
     0100 IRQ4  
     0101 IRQ5  
     0110 IRQ6  
     0111 IRQ7  
     1000 IRQ8  
     1001 IRQ9  
     1010 IRQ10  
     1011 IRQ11  
     1100 IRQ12  
     1101 IRQ13  
     1110 IRQ14  
     1111 Disabled

#### **Offset 3D - Interrupt Pin (04h)..... RO**

**USB-Specific Configuration Registers**
**Offset 40 - Miscellaneous Control 1.....RW**

- 7 PCI Memory Command Option**
  - 0 Support Memory-Read-Line, Memory-Read-Multiple, & Memory-Write-&-Invalidate.... def
  - 1 Only support Mem Read, Mem Write Cmds
- 6 Babble Option**
  - 0 Automatically disable babbled port when EOF babble occurs.....default
  - 1 Don't disable babbled port
- 5 PCI Parity Check Option**
  - 0 Disable PERR# generation.....default
  - 1 Enable parity check and PERR# generation
- 4 Frame Interval Select**
  - 0 1 ms frame.....default
  - 1 0.1 ms frame
- 3 USB Data Length Option**
  - 0 Support TD length up to 1280.....default
  - 1 Support TD length up to 1023
- 2 USB Power Management**
  - 0 Disable USB power management.....default
  - 1 Enable USB power management
- 1 DMA Option**
  - 0 8 DW burst access with better FIFO latency def
  - 1 16 DW burst access (original performance)
- 0 PCI Wait States**
  - 0 Zero wait .....default
  - 1 One wait

**Offset 41 - Miscellaneous Control 2 ..... RW**

- 7 USB 1.1 Improvement for EOP**
  - 0 USB Specification 1.1 Compliant..... default  
If a bit stuffing error occurs before EOP, the receiver will accept the packet
  - 1 USB Specification 1.0 Compliant  
If a bit stuffing error occurs before EOP, the receiver will ignore the packet
- 6-5 Reserved (Do Not Program) ..... default = 0**
- 4 Hold PCI Request for Successive Accesses**
  - 0 Disable
  - 1 Enable ..... default  
Setting this bit to "enable" causes the system to treat the USB request as higher priority
- 3 Frame Counter Test Mode**
  - 0 Disable..... default
  - 1 Enable
- 2 Trap Option**
  - 0 Set trap 60/64 status bits only when trap 60/64 enable bits are set. .... default
  - 1 Set trap 60/64 status bits without checking enable bits
- 1 A20gate Pass Through Option**
  - 0 Pass through A20GATE command sequence defined in UHCI ..... default
  - 1 Don't pass through Write I/O port 64 (ff)
- 0 USB IRQ Test Mode**
  - 0 Normal Operation..... default
  - 1 Generate USB IRQ

**Offset 42 - FIFO Control.....RW**

- 7-4 **Reserved** ..... always reads 0
- 3-2 **Reserved (Do Not Program)**..... default = 0
- 1-0 **Release Continuous REQ After “N” PCICLKs**
  - 00 Do Not Release ..... def
  - 01 N = 32 PCICLKs
  - 10 N = 64 PCICLKs
  - 11 N = 96 PCICLKs

**Offset 60 - Serial Bus Release Number.....RO**

- 7-0 **Release Number**..... always reads 10h

**Offset 83-80 – PM Capability.....RO**

- 31-0 **PM Capability** ..... always reads 00020001h

**Offset 84 – PM Capability Status .....RW**

- 7-0 **PM Capability Status**..... default = 00h  
Supports 00h (Off) and 11h (On) only

**Offset C1-C0 - Legacy Support.....RO**

- 15-0 **UHCI v1.1 Compliant** ..... always reads 2000h

**USB I/O Registers**

These registers are compliant with the UHCI v1.1 standard. Refer to the UHCI v1.1 specification for further details.

**I/O Offset 1-0 - USB Command**
**I/O Offset 3-2 - USB Status**
**I/O Offset 5-4 - USB Interrupt Enable**
**I/O Offset 7-6 - Frame Number**
**I/O Offset B-8 - Frame List Base Address**
**I/O Offset 0C - Start Of Frame Modify**
**I/O Offset 11-10 - Port 0 Status / Control**
**I/O Offset 13-12 - Port 1 Status / Control**

### **Function 3 Registers - USB Controller Ports 2-3**

This Universal Serial Bus host controller interface is fully compatible with UHCI specification v1.1. There are two sets of software accessible registers: PCI configuration registers and USB I/O registers. The PCI configuration registers are located in the function 3 PCI configuration space of the VT8231. The USB I/O registers are defined in UHCI specification v1.1. The registers in this function control USB ports 2-3 (see function 2 for ports 0-1).

#### **PCI Configuration Space Header**

##### **Offset 1-0 - Vendor ID .....RO**

0-7 Vendor ID ..... (1106h = VIA Technologies)

##### **Offset 3-2 - Device ID.....RO**

0-7 Device ID (3038h = VT8231 USB Controller)

##### **Offset 5-4 - Command.....RW**

15-8 Reserved ..... always reads 0  
 7 Address Stepping ..... default=0 (disabled)  
 6 Reserved (parity error response) .....fixed at 0  
 5 Reserved (VGA palette snoop) .....fixed at 0  
 4 Memory Write and Invalidate . default=0 (disabled)  
 3 Reserved (special cycle monitoring) .....fixed at 0  
 2 Bus Master ..... default=0 (disabled)  
 1 Memory Space ..... default=0 (disabled)  
 0 I/O Space ..... default=0 (disabled)

##### **Offset 7-6 - Status.....RWC**

15 Reserved (detected parity error)..... always reads 0  
 14 Signalled System Error..... default=0  
 13 Received Master Abort..... default=0  
 12 Received Target Abort ..... default=0  
 11 Signalled Target Abort..... default=0  
 10-9 DEVSEL# Timing  
   00 Fast  
   01 Medium .....default (fixed)  
   10 Slow  
   11 Reserved  
 8-0 Reserved ..... always reads 0

##### **Offset 8 - Revision ID (nnh)..... RO**

7-0 Silicon Revision Code (0 indicates first silicon)

##### **Offset 9 - Programming Interface (00h) ..... RO**

##### **Offset A - Sub Class Code (03h=USB Controller) ..... RO**

##### **Offset B - Base Class Code (0Ch=Serial Bus Controller)RO**

##### **Offset C - Cache Line Size (00h)..... RO**

##### **Offset D - Latency Timer ..... RW**

7-0 Timer Value ..... default = 16h

##### **Offset E - Header Type (00h)..... RO**

##### **Offset F - BIST (00h)..... RO**

##### **Offset 23-20 - USB I/O Register Base Address..... RW**

31-16 Reserved .....always reads 0  
 15-5 USB I/O Register Base Address. Port Address for the base of the 32-byte USB I/O Register block, corresponding to AD[15:5]  
 4-0 00001b

##### **Offset 3C - Interrupt Line (00h)..... RW**

7-4 Reserved .....always reads 0  
 3-0 USB Interrupt Routing ..... default = 16h  
   0000 Disabled ..... default  
   0001 IRQ1  
   0010 Reserved  
   0011 IRQ3  
   0100 IRQ4  
   0101 IRQ5  
   0110 IRQ6  
   0111 IRQ7  
   1000 IRQ8  
   1001 IRQ9  
   1010 IRQ10  
   1011 IRQ11  
   1100 IRQ12  
   1101 IRQ13  
   1110 IRQ14  
   1111 Disabled

##### **Offset 3D - Interrupt Pin (04h)..... RO**

## USB-Specific Configuration Registers

### Offset 40 - Miscellaneous Control 1.....RW

- 7 **PCI Memory Command Option**
  - 0 Support Memory-Read-Line, Memory-Read-Multiple, & Memory-Write-&-Invalidate.... def
  - 1 Only support Mem Read, Mem Write Cmds
- 6 **Babble Option**
  - 0 Automatically disable babbled port when EOF babble occurs.....default
  - 1 Don't disable babbled port
- 5 **PCI Parity Check Option**
  - 0 Disable PERR# generation.....default
  - 1 Enable parity check and PERR# generation
- 4 **Frame Interval Select**
  - 0 1 ms frame.....default
  - 1 0.1 ms frame
- 3 **USB Data Length Option**
  - 0 Support TD length up to 1280.....default
  - 1 Support TD length up to 1023
- 2 **USB Power Management**
  - 0 Disable USB power management.....default
  - 1 Enable USB power management
- 1 **DMA Option**
  - 0 8 DW burst access with better FIFO latency def
  - 1 16 DW burst access (original performance)
- 0 **PCI Wait States**
  - 0 Zero wait .....default
  - 1 One wait

### Offset 41 - Miscellaneous Control 2 ..... RW

- 7 **USB 1.1 Improvement for EOP**
  - 0 USB Specification 1.1 Compliant..... default  
If a bit stuffing error occurs before EOP, the receiver will accept the packet
  - 1 USB Specification 1.0 Compliant  
If a bit stuffing error occurs before EOP, the receiver will ignore the packet
- 6-5 **Reserved (Do Not Program) ..... default = 0**
- 4 **Hold PCI Request for Successive Accesses**
  - 0 Disable
  - 1 Enable ..... default  
Setting this bit to "enable" causes the system to treat the USB request as higher priority
- 3 **Frame Counter Test Mode**
  - 0 Disable..... default
  - 1 Enable
- 2 **Trap Option**
  - 0 Set trap 60/64 status bits only when trap 60/64 enable bits are set. .... default
  - 1 Set trap 60/64 status bits without checking enable bits
- 1 **A20gate Pass Through Option**
  - 0 Pass through A20GATE command sequence defined in UHCI ..... default
  - 1 Don't pass through Write I/O port 64 (ff)
- 0 **USB IRQ Test Mode**
  - 0 Normal Operation..... default
  - 1 Generate USB IRQ

**Offset 42 - FIFO Control .....RW**

- 7-4 **Reserved** ..... always reads 0
- 3-2 **Reserved (Do Not Program)**..... default = 0
- 1-0 **Release Continuous REQ After “N” PCICLKs**
  - 00 Do Not Release ..... def
  - 01 N = 32 PCICLKs
  - 10 N = 64 PCICLKs
  - 11 N = 96 PCICLKs

**Offset 60 - Serial Bus Release Number.....RO**

- 7-0 **Release Number**..... always reads 10h

**Offset 83-80 – PM Capability.....RO**

- 31-0 **PM Capability** ..... always reads 00020001h

**Offset 84 – PM Capability Status .....RW**

- 7-0 **PM Capability Status**.....supports 00h and 11h only

**Offset C1-C0 - Legacy Support.....RO**

- 15-0 **UHCI v1.1 Compliant** ..... always reads 2000h

**USB I/O Registers**

These registers are compliant with the UHCI v1.1 standard. Refer to the UHCI v1.1 specification for further details.

**I/O Offset 1-0 - USB Command**
**I/O Offset 3-2 - USB Status**
**I/O Offset 5-4 - USB Interrupt Enable**
**I/O Offset 7-6 - Frame Number**
**I/O Offset B-8 - Frame List Base Address**
**I/O Offset 0C - Start Of Frame Modify**
**I/O Offset 11-10 - Port 0 Status / Control**
**I/O Offset 13-12 - Port 1 Status / Control**



## **Function 4 Regs - Power Management, SMBus and HWM**

This section describes the ACPI (Advanced Configuration and Power Interface) Power Management system of the VT8231 which includes a System Management Bus (SMBus) interface controller and Hardware Monitoring (HWM) subsystem. The power management system of the VT8231 supports both ACPI and legacy power management functions and is compatible with the APM v1.2 and ACPI v1.0 specifications.

### **PCI Configuration Space Header**

#### **Offset 1-0 - Vendor ID .....RO**

0-7 Vendor ID ..... (1106h = VIA Technologies)

#### **Offset 3-2 - Device ID .....RO**

0-7 Device ID ..... (3057h = ACPI Power Mgmt)

#### **Offset 5-4 - Command .....RW**

15-8 Reserved ..... always reads 0  
 7 Address Stepping .....fixed at 0  
 6 Reserved (parity error response) .....fixed at 0  
 5 Reserved (VGA palette snoop) .....fixed at 0  
 4 Memory Write and Invalidate .....fixed at 0  
 3 Reserved (special cycle monitoring) .....fixed at 0  
 2 Bus Master .....fixed at 0  
 1 Memory Space .....fixed at 0  
 0 I/O Space .....fixed at 0

#### **Offset 7-6 - Status .....RWC**

15 Detected Parity Error ..... always reads 0  
 14 Signalled System Error ..... always reads 0  
 13 Received Master Abort ..... always reads 0  
 12 Received Target Abort ..... always reads 0  
 11 Signalled Target Abort ..... always reads 0  
 10-9 DEVSEL# Timing  
     00 Fast  
     01 Medium .....default (fixed)  
     10 Slow  
     11 Reserved  
 8 Data Parity Detected ..... always reads 0  
 7 Fast Back to Back Capable ..... always reads 1  
 6-0 Reserved ..... always reads 0

#### **Offset 8 - Revision ID (nnh) .....RO**

7-0 Silicon Revision Code

#### **Offset 9 - Programming Interface (00h) .....RO**

The value returned by this register may be changed by writing the desired value to PCI Configuration Function 4 offset 61h.

#### **Offset A - Sub Class Code (00h) .....RO**

The value returned by this register may be changed by writing the desired value to PCI Configuration Function 4 offset 62h.

#### **Offset B - Base Class Code (00h) .....RO**

The value returned by this register may be changed by writing the desired value to PCI Configuration Function 4 offset 63h.

#### **Offset 0D - Latency Timer .....RW**

7-0 Timer Value ..... default = 0

#### **Offset 0E - Header Type (00h) .....RO**

**Power Management-Specific PCI Configuration Registers**
**Offset 40 – General Configuration 0 .....RW**

- 7 Thermal Alarm Source Select**
  - 0 From pin T11 (Function 0 Rx74[1] must be set to define the pin as THRM#).....default
  - 1 From any of the three internal temperature sensing circuits (see Rx43 and Rx44 of Hardware Monitoring configuration space)
- 6 Sleep Button**
  - 0 Disable .....default
  - 1 Sleep Button is on IRQ6 pin (pin G1)
- 5 Debounce LID and PWRBTN# Inputs for 200us**
  - 0 Disable .....default
  - 1 Enable
- 4 Reserved** ..... always reads 0
- 3 Microsoft Sound Monitor in Audio Access**
  - 0 Disable .....default
  - 1 Enable
- 2 Game Port Monitor in Audio Access**
  - 0 Disable .....default
  - 1 Enable
- 1 SoundBlaster Monitor in Audio Access**
  - 0 Disable .....default
  - 1 Enable
- 0 MIDI Monitor in Audio Access**
  - 0 Disable .....default
  - 1 Enable

**Offset 41 - General Configuration 1..... RW**

- 7 I/O Enable for ACPI I/O Base**
  - 0 Disable access to ACPI I/O block..... default
  - 1 Allow access to Power Management I/O Register Block (see offset 4B-48 to set the base address for this register block). The definitions of the registers in the Power Management I/O Register Block are included later in this document, following the Power Management Subsystem overview.
- 6 ACPI Timer Reset**
  - 0 Normal Timer Operation ..... default
  - 1 Reset Timer
- 5-4 PMU Timer Test Mode (Do Not Program) ....def = 0**
- 3 ACPI Timer Count Select**
  - 0 24-bit Timer ..... default
  - 1 32-bit Timer
- 2 RTC Enable Signal Gated with PSON (SUSC#) in Soft-Off Mode**
  - 0 Disable..... default
  - 1 Enable
- 1 Clock Throttling Clock Selection**
  - 0 32 usec (512 usec cycle time) ..... default
  - 1 1 msec (16 msec cycle time)
- 0 DEVSEL# Test Mode (Do Not Program).....def = 0**

**Offset 42 - ACPI Interrupt Select .....RW**

|      |                                            |
|------|--------------------------------------------|
| 7    | ATX / AT Power Indicator..... RO           |
| 0    | ATX                                        |
| 1    | AT                                         |
| 6    | SUSC# State..... RO                        |
| 5    | Reserved ..... always reads 0              |
| 4    | SUSC# AC-Power-On Default Value ..... RO   |
|      | This bit is written at RTC Index 0A bit-7. |
| 3-0  | SCI Interrupt Assignment                   |
| 0000 | Disabled .....default                      |
| 0001 | IRQ1                                       |
| 0010 | Reserved                                   |
| 0011 | IRQ3                                       |
| 0100 | IRQ4                                       |
| 0101 | IRQ5                                       |
| 0110 | IRQ6                                       |
| 0111 | IRQ7                                       |
| 1000 | IRQ8                                       |
| 1001 | IRQ9                                       |
| 1010 | IRQ10                                      |
| 1011 | IRQ11                                      |
| 1100 | IRQ12                                      |
| 1101 | IRQ13                                      |
| 1110 | IRQ14                                      |
| 1111 | IRQ15                                      |

**Offset 43 – Internal Timer Read Test.....RO**

|     |                          |
|-----|--------------------------|
| 7-0 | Internal Timer Read Test |
|-----|--------------------------|

**Offset 45-44 - Primary Interrupt Channel (0000h) ..... RW**

|    |                                                |
|----|------------------------------------------------|
| 15 | 1/0 = Ena/Disa IRQ15 as Primary Intrpt Channel |
| 14 | 1/0 = Ena/Disa IRQ14 as Primary Intrpt Channel |
| 13 | 1/0 = Ena/Disa IRQ13 as Primary Intrpt Channel |
| 12 | 1/0 = Ena/Disa IRQ12 as Primary Intrpt Channel |
| 11 | 1/0 = Ena/Disa IRQ11 as Primary Intrpt Channel |
| 10 | 1/0 = Ena/Disa IRQ10 as Primary Intrpt Channel |
| 9  | 1/0 = Ena/Disa IRQ9 as Primary Intrpt Channel  |
| 8  | 1/0 = Ena/Disa IRQ8 as Primary Intrpt Channel  |
| 7  | 1/0 = Ena/Disa IRQ7 as Primary Intrpt Channel  |
| 6  | 1/0 = Ena/Disa IRQ6 as Primary Intrpt Channel  |
| 5  | 1/0 = Ena/Disa IRQ5 as Primary Intrpt Channel  |
| 4  | 1/0 = Ena/Disa IRQ4 as Primary Intrpt Channel  |
| 3  | 1/0 = Ena/Disa IRQ3 as Primary Intrpt Channel  |
| 2  | Reserved .....always reads 0                   |
| 1  | 1/0 = Ena/Disa IRQ1 as Primary Intrpt Channel  |
| 0  | 1/0 = Ena/Disa IRQ0 as Primary Intrpt Channel  |

**Offset 47-46 - Secondary Interrupt Channel (0000h).... RW**

|    |                                                |
|----|------------------------------------------------|
| 15 | 1/0 = Ena/Disa IRQ15 as Secondary Intr Channel |
| 14 | 1/0 = Ena/Disa IRQ14 as Secondary Intr Channel |
| 13 | 1/0 = Ena/Disa IRQ13 as Secondary Intr Channel |
| 12 | 1/0 = Ena/Disa IRQ12 as Secondary Intr Channel |
| 11 | 1/0 = Ena/Disa IRQ11 as Secondary Intr Channel |
| 10 | 1/0 = Ena/Disa IRQ10 as Secondary Intr Channel |
| 9  | 1/0 = Ena/Disa IRQ9 as Secondary Intr Channel  |
| 8  | 1/0 = Ena/Disa IRQ8 as Secondary Intr Channel  |
| 7  | 1/0 = Ena/Disa IRQ7 as Secondary Intr Channel  |
| 6  | 1/0 = Ena/Disa IRQ6 as Secondary Intr Channel  |
| 5  | 1/0 = Ena/Disa IRQ5 as Secondary Intr Channel  |
| 4  | 1/0 = Ena/Disa IRQ4 as Secondary Intr Channel  |
| 3  | 1/0 = Ena/Disa IRQ3 as Secondary Intr Channel  |
| 2  | Reserved .....always reads 0                   |
| 1  | 1/0 = Ena/Disa IRQ1 as Secondary Intr Channel  |
| 0  | 1/0 = Ena/Disa IRQ0 as Secondary Intr Channel  |

**Offset 4B-48 – Power Management I/O Base .....RW**

**31-16 Reserved** ..... always reads 0

**15-7 Power Management I/O Register Base Address.**

Port Address for the base of the 128-byte Power Management I/O Register block, corresponding to AD[15:7]. The "I/O Space" bit at offset 41 bit-7 enables access to this register block. The definitions of the registers in the Power Management I/O Register Block are included later in this document, following the Power-Management-Specific PCI Configuration register descriptions and the Power Management Subsystem overview.

**6-0 0000001b**

**Offset 4C – Host Bus Power Management Control.....RW**

**7-4 Thermal Duty Cycle (THM\_DTY)**

This 4-bit field determines the duty cycle of the STPCLK# signal when the THRM# pin is asserted low. The field is decoded as follows:

0000 Reserved.....default  
 0001 0-6.25%  
 0010 6.25-12.50%  
 0011 18.75-25.00%  
 0100 31.25-37.50%  
 0101 37.50-43.75%  
 0110 43.75-50.00%  
 0111 50.00-56.25%  
 1000 56.25-62.50%  
 1001 62.50-68.75%  
 1010 68.75-75.00%  
 1011 75.00-87.50%  
 1100 75.00-81.25%  
 1101 81.25-87.50%  
 1110 87.50-93.75%  
 1111 93.75-100%

**3 THRM Enable**

0 Disable .....default  
 1 Enable

**2 Frame Input as Resume Event in C3**

0 Disable .....default  
 1 Enable

**1 Reserved** ..... always reads 0

**0 CPU Stop Grant Cycle Select**

0 From Halt and Stop Grant Cycle.....default  
 1 From Stop Grant Cycle

This bit is combined with I/O space Rx2C[3] for controlling the start of CPUSTP# assertion during system suspend mode:

| <u>Rx2C[3]</u> | <u>Rx4C[0]</u> | <u>CPUSTP# Assertion</u>                |
|----------------|----------------|-----------------------------------------|
| 0              | x              | Immediate                               |
| 1              | 0              | Wait for CPU Halt<br>/ Stop Grant cycle |
| 1              | 1              | Wait for CPU<br>Stop Grant cycle        |

**Offset 4D – Throttle / Clock Stop Control..... RW**

**7 Throttle Timer Reset**.....def = 0

**6-5 Throttle Timer**

0x 4-Bit ..... default  
 10 3-Bit  
 11 2-Bit

**4 Fast Clock (7.5us) as Throttle Timer Tick**

0 Disable..... default  
 1 Enable

**3 Reserved** .....always reads 0

**2 Internal Clock Stop for PCI Idle**

0 Disable..... default  
 1 Enable

**1 Internal Clock Stop During C3**

0 Disable..... default  
 1 Enable

**0 Internal Clock Stop During Suspend**

0 Disable..... default  
 1 Enable

**Offset 53-50 - GP Timer Control (0000 0000h) .....RW**
**31-30 Conserve Mode Timer Count Value**

- 00 1/16 second .....default
- 01 1/8 second
- 10 1 second
- 11 1 minute

**29 Conserve Mode Status**

This bit reads 1 when in Conserve Mode

**28 Conserve Mode Enable**

- 0 Disable .....default
- 1 Enable

**27-26 Secondary Event Timer Count Value**

- 00 2 milliseconds.....default
- 01 64 milliseconds
- 10 ½ second
- 11 by EOI + 0.25 milliseconds

**25 Secondary Event Occurred Status**

This bit reads 1 to indicate that a secondary event has occurred (to resume the system from suspend) and the secondary event timer is counting down.

**24 Secondary Event Timer Enable**

- 0 Disable .....default
- 1 Enable

**23-16 GP1 Timer Count Value (base defined by bits 5-4)**

Write to load count value; Read to get current count

**15-8 GP0 Timer Count Value (base defined by bits 1-0)**

Write to load count value; Read to get current count

**7 GP1 Timer Start**

On setting this bit to 1, the GP1 timer loads the value defined by bits 23-16 of this register and starts counting down. The GP1 timer is reloaded at the occurrence of certain peripheral events enabled in the GP Timer Reload Enable Register (Power Management I/O Space Offset 38h). If no such event occurs and the GP1 timer counts down to zero, then the GP1 Timer Timeout Status bit is set to one (bit-3 of the Global Status register at Power Management Register I/O Space Offset 28h). Additionally, if the GP1 Timer Timeout Enable bit is set (bit-3 of the Global Enable register at Power Management Register I/O Space Offset 2Ah), then an SMI is generated.

**6 GP1 Timer Automatic Reload**

- 0 GP1 Timer stops at 0 .....default
- 1 Reload GP1 timer automatically after counting down to 0

**5-4 GP1 Timer Base**

- 00 Disable .....default
- 01 1/4 msec
- 10 1 second
- 11 1 minute

**3 GP0 Timer Start**

On setting this bit to 1, the GP0 timer loads the value defined by bits 15-8 of this register and starts counting down. The GP0 timer is reloaded at the occurrence of certain peripheral events enabled in the GP Timer Reload Enable Register (Power Management I/O Space Offset 38h). If no such event occurs and the GP0 timer counts down to zero, then the GP0 Timer Timeout Status bit is set to one (bit-2 of the Global Status register at Power Management Register I/O Space Offset 28h). Additionally, if the GP0 Timer Timeout Enable bit is set (bit-2 of the Global Enable register at Power Management Register I/O Space Offset 2Ah), then an SMI is generated.

**2 GP0 Timer Automatic Reload**

- 0 GP0 Timer stops at 0 ..... default
- 1 Reload GP0 timer automatically after counting down to 0

**1-0 GP0 Timer Base**

- 00 Disable..... default
- 01 1/16 second
- 10 1 second
- 11 1 minute

**Offset 54 – Power Well Control..... WO**

- 7 SMBus Clock Select**
  - 0 SMBus Clock from 14.31818 MHz Divider def
  - 1 SMBus Clock from RTC 32.768 KHz
- 6 STR Power Well Output Gating**
  - 0 Disable .....default
  - 1 Enable
- 5 SUSC# = 0 for STR**
  - 0 Disable .....default
  - 1 Enable
- 4 SUSST1# / GPO3 Select (Pin V10)**
  - 0 SUSST1#.....default
  - 1 GPO3
- 3 GPO2 / SUSB# Select (Pin W9)**
  - 0 SUSB#.....default
  - 1 GPO2

Before chip rev C, these definitions were reversed
- 2 GPO1 / SUSA# Select (Pin V9)**
  - 0 SUSA# .....default
  - 1 GPO1

Before chip rev C, these definitions were reversed
- 1-0 GPO0 (SLOWCLK) Output Selection (Pin T8)**
  - 00 From GPO0 (PMU I/O Rx4C[0]).....default
  - 01 1 Hz
  - 10 4 Hz
  - 11 16 Hz

**Offset 55 – USB Wakeup..... RW**

- 7-1 Reserved** .....always reads 0
- 0 USB Wakeup for STR/STD/Soff**
  - 0 Disable..... default
  - 1 Enable

**Offset 58 – GP2 / GP3 Timer Control .....RW**
**7 GP3 Timer Start**

On setting this bit to 1, the GP3 timer loads the value defined by Rx5A and starts counting down. The GP3 timer is reloaded at the occurrence of certain events enabled in the GP Timer Reload Enable Register (Power Management I/O Space Offset 38h). If no such event occurs and the GP3 timer counts down to zero, then the GP3 Timer Timeout Status bit is set to one (bit-13 of the Global Status register at Power Management Register I/O Space Offset 28h). Additionally, if the GP3 Timer Timeout Enable bit is set (bit-13 of the Global Enable register at Power Management Register I/O Space Offset 2Ah), then an SMI is generated.

**6 GP3 Timer Automatic Reload**

- 0 GP3 Timer stops at 0 .....default
- 1 Reload GP3 timer automatically after counting down to 0

**5-4 GP3 Timer Tick Select**

- 00 Disable .....default
- 01 1/4 millisecond
- 10 1 second
- 11 1 minute

**3 GP2 Timer Start**

On setting this bit to 1, the GP2 timer loads the value defined by Rx59 and starts counting down. The GP2 timer is reloaded at the occurrence of certain events enabled in the GP Timer Reload Enable Register (Power Management I/O Space Offset 38h). If no such event occurs and the GP2 timer counts down to zero, then the GP2 Timer Timeout Status bit is set to one (bit-12 of the Global Status register at Power Management Register I/O Space Offset 28h). Additionally, if the GP2 Timer Timeout Enable bit is set (bit-12 of the Global Enable register at Power Management Register I/O Space Offset 2Ah), then an SMI is generated.

**2 GP2 Timer Automatic Reload**

- 0 GP2 Timer stops at 0 .....default
- 1 Reload GP2 timer automatically after counting down to 0

**1-0 GP2 Timer Tick Select**

- 00 Disable .....default
- 01 1/16 second
- 10 1 second
- 11 1 minute

**Offset 59 – GP2 Timer..... RW**

- 7 **Write: GP2 Timer Load Value.....default = 0**  
**Read: GP2 Timer Current Count**

**Offset 5A – GP3 Timer..... RW**

- 7 **Write: GP3 Timer Load Value.....default = 0**  
**Read: GP3 Timer Current Count**

**Offset 61 – Program Interface Read Value..... WO****7-0 Rx09 Read Value**

The value returned by the register at offset 9h (Programming Interface) may be changed by writing the desired value to this location.

**Offset 62 - Sub Class Read Value..... WO****7-0 Rx0A Read Value**

The value returned by the register at offset 0Ah (Sub Class Code) may be changed by writing the desired value to this location.

**Offset 63 - Base Class Read Value..... WO****7-0 Rx0B Read Value**

The value returned by the register at offset 0Bh (Base Class Code) may be changed by writing the desired value to this location.



### Hardware-Monitor-Specific Configuration Registers

#### Offset 71-70 – Hardware Monitor I/O Base .....RW

- 15-7 I/O Base (128-byte I/O space) ..... default = 0
- 6-0 Fixed ..... always reads 0000001b

#### Offset 74 –Hardware Monitor Control .....RW

- 7-4 Reserved ..... always reads 0
- 3 **Hardware Monitoring Interrupt**
  - 0 SMI .....default
  - 1 SCI
- 2-1 Reserved ..... always reads 0
- 0 **Hardware Monitoring I/O Enable**
  - 0 Disable hardware monitor functions.....default
  - 1 Enable hardware monitor functions

### System Management Bus-Specific Configuration Registers

#### Offset 93-90 – SMBus I/O Base ..... RW

- 31-16 Reserved .....always reads 0
- 15-4 I/O Base (16-byte I/O space)..... default = 00h
- 3-0 Fixed .....always reads 0001b

#### Offset D2 – SMBus Host Configuration ..... RW

- 7-4 Reserved .....always reads 0
- 3 **SMBus Interrupt Select**
  - 0 SMI ..... default
  - 1 SCI
- 2 Reserved .....always reads 0
- 1 **SMBus IRQ**
  - 0 Disable..... default
  - 1 Enable
- 0 **SMBus Host Controller Enable**
  - 0 Disable SMB controller functions ..... default
  - 1 Enable SMB controller functions

#### Offset D3 – SMBus Host Slave Command..... RW

- 7-0 SMBus Host Slave Command Code ..... default=0

#### Offset D4 – SMBus Slave Address for Port 1..... RW

- 7-0 SMBus Slave Address for Port 1 ..... default=0
- Bit-0 must be set to 0 for proper operation

#### Offset D5 – SMBus Slave Address for Port 2..... RW

- 7-0 SMBus Slave Address for Port 2 ..... default=0
- Bit-0 must be set to 0 for proper operation

#### Offset D6 – SMBus Revision ID ..... RO

- 7-0 SMBus Revision Code

## **Power Management I/O-Space Registers**

### **Basic Power Management Control and Status**

#### **I/O Offset 1-0 - Power Management Status .....RWC**

The bits in this register are set only by hardware and can be reset by software by writing a one to the desired bit position.

- 15 Wakeup Status (WAK\_STS) ..... default = 0**  
This bit is set when the system is in the suspend state and an enabled resume event occurs. Upon setting this bit, the system automatically transitions from the suspend state to the normal working state (from C3 to C0 for the processor).
- 14-12 Reserved ..... always reads 0**
- 11 Abnormal Power-Off (APO\_STS)..... default = 0**
- 10 RTC Status (RTC\_STS) ..... default = 0**  
This bit is set when the RTC generates an alarm (on assertion of the RTC IRQ signal).
- 9 Sleep Button Status (SB\_STS)..... default = 0**  
This bit is set when the sleep button (SLPBTN# / IRQ6 / GPI4) is pressed.
- 8 Power Button Status (PB\_STS)..... default = 0**  
This bit is set when the PWRBTN# signal is asserted LOW. If the PWRBTN# signal is held LOW for more than four seconds, this bit is cleared, the PBOR\_STS bit is set, and the system will transition into the soft off state.
- 7-6 Reserved ..... always reads 0**
- 5 Global Status (GBL\_STS)..... default = 0**  
This bit is set by hardware when BIOS\_RLS is set (typically by an SMI routine to release control of the SCI/SMI lock). When this bit is cleared by software (by writing a one to this bit position) the BIOS\_RLS bit is also cleared at the same time by hardware.
- 4 Bus Master Status (BM\_STS) ..... default = 0**  
This bit is set when a system bus master requests the system bus. All PCI master, ISA master and ISA DMA devices are included.
- 3-1 Reserved ..... always reads 0**
- 0 ACPI Timer Carry Status (TMR\_STS).. default = 0**  
The bit is set when the 23<sup>rd</sup> (31st) bit of the 24 (32) bit ACPI power management timer changes.

#### **I/O Offset 3-2 - Power Management Enable ..... RW**

The bits in this register correspond to the bits in the Power Management Status Register at offset 1-0.

- 15 Reserved .....always reads 0**
- 14-12 Reserved .....always reads 0**
- 11 Reserved .....always reads 0**
- 10 RTC Enable (RTC\_EN)..... default = 0**  
This bit may be set to trigger either an SCI or an SMI (depending on the setting of the SCI\_EN bit) to be generated when the RTC\_STS bit is set.
- 9 Sleep Button Enable (SB\_EN) ..... default = 0**  
This bit may be set to trigger either an SCI or SMI when the SB\_STS bit is set.
- 8 Power Button Enable (PB\_EN) ..... default = 0**  
This bit may be set to trigger either an SCI or an SMI (depending on the setting of the SCI\_EN bit) to be generated when the PB\_STS bit is set.
- 7-6 Reserved .....always reads 0**
- 5 Global Enable (GBL\_EN)..... default = 0**  
This bit may be set to trigger either an SCI or an SMI (depending on the setting of the SCI\_EN bit) to be generated when the GBL\_STS bit is set.
- 4 Reserved .....always reads 0**
- 3-1 Reserved .....always reads 0**
- 0 ACPI Timer Enable (TMR\_EN) ..... default = 0**  
This bit may be set to trigger either an SCI or an SMI (depending on the setting of the SCI\_EN bit) to be generated when the TMR\_STS bit is set.

**I/O Offset 5-4 - Power Management Control .....RW**

- 15 Soft Resume**
- 14 Reserved** ..... always reads 0
- 13 Sleep Enable (SLP\_EN)**..... always reads 0

This is a write-only bit; reads from this bit always return zero. Writing a one to this bit causes the system to sequence into the sleep (suspend) state defined by the SLP\_TYP field.

**12-10 Sleep Type (SLP\_TYP)**

- 000 Normal On
- 001 Suspend to RAM (STR)
- 010 Suspend to Disk (STD) (also called Soft Off).  
The VCC power plane is turned off while the VCCS and VBAT planes remain on.
- 011 Reserved
- 100 Power On Suspend without Reset
- 101 Power On Suspend with CPU Reset
- 110 Power On Suspend with CPU/PCI Reset
- 111 Reserved

In any sleep state, there is minimal interface between powered and non-powered planes so that the effort for hardware design may be well managed.

- 9-3 Reserved** ..... always reads 0

- 2 Global Release (GBL\_RLS)** ..... **WO**, default = 0  
This bit is set by ACPI software to indicate the release of the SCI / SMI lock. Upon setting of this bit, the hardware automatically sets the BIOS\_STS bit. The bit is cleared by hardware when the BIOS\_STS bit is cleared by software. Note that the setting of this bit will cause an SMI to be generated if the BIOS\_EN bit is set (bit-5 of the Global Enable register at offset 2Ah).

**1 Bus Master Reload (BMS\_RLD)**

- 0 Bus master requests are ignored by power management logic.....default
- 1 Bus master requests transition the processor from the C3 state to the C0 state

**0 SCI Enable (SCI\_EN)**

Selects the power management event to generate either an SCI or SMI:

- 0 Generate SCI .....default
- 1 Generate SMI

Note that certain power management events can be programmed individually to generate an SCI or SMI independent of the setting of this bit (refer to the General Purpose SCI Enable and General Purpose SMI Enable registers at offsets 22 and 24). Also, TMR\_STS & GBL\_STS always generate SCI and BIOS\_STS always generates SMI.

**I/O Offset 0B-08 - Power Management Timer ..... RW**
**31-24 Extended Timer Value (ETM\_VAL)**

This field reads back 0 if the 24-bit timer option is selected (Rx41 bit-3).

**23-0 Timer Value (TMR\_VAL)**

This read-only field returns the running count of the power management timer. This is a 24/32-bit counter that runs off a 3.579545 MHz clock, and counts while in the S0 (working) system state. The timer is reset to an initial value of zero during a reset, and then continues counting until the 14.31818 MHz input to the chip is stopped. If the clock is restarted without a reset, then the counter will continue counting from where it stopped.

## Processor Power Management Registers

### I/O Offset 13-10 - Processor & PCI Bus Control.....RW

- 31-12 Reserved** ..... always reads 0
- 11 PCI Stop (PCISTP# asserted) when PCKRUN# is Deasserted (PCI\_STP)**
- 0 Enable.....default
- 1 Disable
- 10 PCI Bus Clock Run Without Stop (PCI\_RUN)**
- 0 PCKRUN# will be de-activated after the PCI bus is idle for 26 clocks.....default
- 1 PCKRUN# is always asserted
- 9 Host Clock Stop Enable (HOST\_STP)**
- 0 STPCLK# will be asserted in the C3 state, but the CPU clock is not stopped .....default
- 1 CPU clock is stopped in the C3 state
- 8 Assert SLP# for Processor Level 3 Read**
- 0 Disable .....default
- 1 Enable
- Used in Slot-1 systems only.
- 7-5 Reserved** ..... always reads 0
- 4 Throttling Enable (THT\_EN)**
- Setting this bit starts clock throttling (modulating the STPCLK# signal) regardless of the CPU state. The throttling duty cycle is determined by bits 3-0 of this register.
- 3-0 Throttling Duty Cycle (THT\_DTY)**
- This 4-bit field determines the duty cycle of the STPCLK# signal when the system is in throttling mode (the "Throttling Enable" bit is set to one). The duty cycle indicates the percentage of time the STPCLK# signal is asserted while the Throttling Enable bit is set. The field is decoded as follows:
- 0000 Reserved
- 0001 0-6.25%
- 0010 6.25-12.50%
- 0011 18.75-25.00%
- 0100 31.25-37.50%
- 0101 37.50-43.75%
- 0110 43.75-50.00%
- 0111 50.00-56.25%
- 1000 56.25-62.50%
- 1001 62.50-68.75%
- 1010 68.75-75.00%
- 1011 75.00-87.50%
- 1100 75.00-81.25%
- 1101 81.25-87.50%
- 1110 87.50-93.75%
- 1111 93.75-100%

### I/O Offset 14 - Processor Level 2..... RO

- 7-0 Level 2** .....always reads 0
- Reads from this register put the processor into the Stop Grant state (the VT8231 asserts STPCLK# to suspend the processor). Wake up from Stop Grant state is by interrupt (INTR, SMI, and SCI).

Reads from this register return all zeros; writes to this register have no effect.

### I/O Offset 15 - Processor Level 3..... RO

- 7-0 Level 3** .....always reads 0
- Reads from this register put the processor in the C3 clock state with the STPCLK# signal asserted. If Rx10[9] = 1 then the CPU clock is also stopped by asserting CPUTP#. Wakeup from the C3 state is by interrupt (INTR, SMI, and SCI).

Reads from this register return all zeros; writes to this register have no effect.

## General Purpose Power Management Registers

### I/O Offset 21-20 - General Purpose Status (GP\_STS).RWC

- 15 **Reserved** ..... always reads 0
- 14 **USB Wake-Up Status (UWAK\_STS)**  
For STR / STD / Soff
- 13 **AC97 Wake-Up Status (AWAK\_STS)**  
Can be set only in suspend mode
- 12 **Battery Low Status (BL\_STS)**  
This bit is set when the BATLOW# input is asserted low.
- 11 **Notebook Lid Status (LID\_STS)**  
This bit is set when the LID input detects the edge selected by Rx2C bit-7 (0=rising, 1=falling).
- 10 **Thermal Detect Status (THRM\_STS)**  
This bit is set when the THRM input detects the edge selected by Rx2C bit-6 (0=rising, 1=falling).
- 9 **USB Resume Status (USB\_STS)**  
This bit is set when a USB peripheral generates a resume event.
- 8 **Ring Status (RING\_STS)**  
This bit is set when the RING# input is asserted low.
- 7 **GPI18 Toggle Status (GPI18\_STS)**  
This bit is set when the GPI18 pin is toggled.
- 6 **GPI6 / EXTSMI6 Toggle Status (GPI6\_STS)**  
This bit is set when the GPI6 pin is toggled.
- 5 **GPI5 Toggle Status (GPI5\_STS)**  
This bit is set when the GPI5 pin is toggled.
- 4 **GPI4 / EXTSMI4 Toggle Status (GPI4\_STS)**  
This bit is set when the GPI4 pin is toggled.
- 3 **GPI17 Toggle Status (GPI17\_STS)**  
This bit is set when the GPI17 pin is toggled.
- 2 **GPI16 Toggle Status (GPI16\_STS)**  
This bit is set when the GPI16 pin is toggled.
- 1 **GPI1 Toggle Status (GPI1\_STS)**  
This bit is set when the GPI1 pin is toggled.
- 0 **EXTSMI# Status (EXT\_STS)**  
This bit is set when the EXTSMI# pin is asserted low.

Note that the above bits correspond one for one with the bits of the General Purpose SCI Enable and General Purpose SMI Enable registers at offsets 22 and 24: an SCI or SMI is generated if the corresponding bit of the General Purpose SCI or SMI Enable registers, respectively, is set to one.

The above bits are set by hardware only and can only be cleared by writing a one to the desired bit.

### I/O Offset 23-22 - General Purpose SCI Enable ..... RW

- 15 **Reserved** ..... always reads 0
- 14 **Enable SCI on setting of the UWAK\_STS bit** def=0
- 13 **Enable SCI on setting of the AWAK\_STS bit** def=0
- 12 **Enable SCI on setting of the BL\_STS bit** .....def=0
- 11 **Enable SCI on setting of the LID\_STS bit** .....def=0
- 10 **Enable SCI on setting of the THRM\_STS bit** def=0
- 9 **Enable SCI on setting of the USB\_STS bit** ....def=0
- 8 **Enable SCI on setting of the RING\_STS bit** .def=0
- 7 **Enable SCI on setting of the GPI18\_STS bit**..def=0
- 6 **Enable SCI on setting of the GPI6\_STS bit**....def=0
- 5 **Enable SCI on setting of the GPI5\_STS bit**....def=0
- 4 **Enable SCI on setting of the GPI4\_STS bit**....def=0
- 3 **Enable SCI on setting of the GPI17\_STS bit**..def=0
- 2 **Enable SCI on setting of the GPI16\_STS bit**..def=0
- 1 **Enable SCI on setting of the GPI1\_STS bit**....def=0
- 0 **Enable SCI on setting of the EXT\_STS bit** ....def=0

These bits allow generation of an SCI using a separate set of conditions from those used for generating an SMI.

### I/O Offset 25-24 - General Purpose SMI Enable ..... RW

- 15-14 **Reserved** ..... always reads 0
- 13 **Enable SMI on setting of the AWAK\_STS bit** def=0
- 12 **Enable SMI on setting of the BL\_STS bit** .....def=0
- 11 **Enable SMI on setting of the LID\_STS bit** ....def=0
- 10 **Enable SMI on setting of the THRM\_STS bit** def=0
- 9 **Enable SMI on setting of the USB\_STS bit** ...def=0
- 8 **Enable SMI on setting of the RING\_STS bit** def=0
- 7 **Enable SMI on setting of the GPI18\_STS bit**..def=0
- 6 **Enable SMI on setting of the GPI6\_STS bit**...def=0
- 5 **Enable SMI on setting of the GPI5\_STS bit**...def=0
- 4 **Enable SMI on setting of the GPI4\_STS bit**...def=0
- 3 **Enable SMI on setting of the GPI17\_STS bit**..def=0
- 2 **Enable SMI on setting of the GPI16\_STS bit**..def=0
- 1 **Enable SMI on setting of the GPI1\_STS bit**...def=0
- 0 **Enable SMI on setting of the EXT\_STS bit**....def=0

These bits allow generation of an SMI using a separate set of conditions from those used for generating an SCI.

**Generic Power Management Registers**
**I/O Offset 29-28 - Global Status.....RWC**

- 15 **GPIO Range 1 Access Status (GR1\_STS)** ..... def=0
- 14 **GPIO Range 0 Access Status (GR0\_STS)** ..... def=0
- 13 **GP3 Timer Timeout Status (G3TO\_STS)** ..... def=0
- 12 **GP2 Timer Timeout Status (G2TO\_STS)** ..... def=0
- 11 **SERIRQ SMI Status (SSMI\_STS)**..... def=0
- 10-9 **Reserved** ..... always reads 0
- 8 **PCKRUN# Resume Status (PRRSM\_STS)**.... def=0  
This bit is set when PCI bus peripherals wake up the system by asserting PCKRUN#
- 7 **Primary IRQ Resume Status (PIRSM\_STS)** . def=0  
This bit is set at the occurrence of primary IRQs as defined in Rx45-44 of PCI configuration space
- 6 **Software SMI Status (SW\_SMI\_STS)**..... def=0  
This bit is set when the SMI\_CMD port (offset 2F) is written.
- 5 **BIOS Status (BIOS\_STS)**..... def=0  
This bit is set when the GBL\_RLS bit is set to one (typically by the ACPI software to release control of the SCI/SMI lock). When this bit is reset (by writing a one to this bit position) the GBL\_RLS bit is reset at the same time by hardware.
- 4 **Legacy USB Status (LEG\_USB\_STS)** ..... def=0  
This bit is set when a legacy USB event occurs.
- 3 **GP1 Timer Time Out Status (GP1TO\_STS)**.. def=0  
This bit is set when the GP1 timer times out.
- 2 **GP0 Timer Time Out Status (GP0TO\_STS)**.. def=0  
This bit is set when the GP0 timer times out.
- 1 **Secondary Event Timer Time Out Status (STTO\_STS)**..... def=0  
This bit is set when the secondary event timer times out.
- 0 **Primary Activity Status (PACT\_STS)**..... def=0  
This bit is set at the occurrence of any enabled primary system activity (see the Primary Activity Detect Status register at offset 30h and the Primary Activity Detect Enable register at offset 34h). After checking this bit, software can check the status bits in the Primary Activity Detect Status register at offset 30h to identify the specific source of the primary event. Note that setting this bit can be enabled to reload the GP0 timer (see bit-0 of the GP Timer Reload Enable register at offset 38).

**I/O Offset 2B-2A - Global Enable ..... RW**

- 15 **GPIO Range 1 SMI Enable (GR1\_EN)** ..... def=0
- 14 **GPIO Range 0 SMI Enable (GR0\_EN)** ..... def=0
- 13 **GP3 Timer Timeout SMI Enable (G3TO\_EN)** def=0
- 12 **GP2 Timer Timeout SMI Enable (G2TO\_EN)** def=0
- 11 **SERIRQ SMI Enable (SSMI\_EN)** ..... def=0
- 10-9 **Reserved** ..... always reads 0
- 8 **PCKRUN# Resume Enable (PRRSM\_EN)** .... def=0  
This bit may be set to trigger an SMI to be generated when the PRRSM\_STS bit is set.
- 7 **Primary IRQ Resume Enable (PIRSM\_EN)**.. def=0  
This bit may be set to trigger an SMI to be generated when the PIRSM\_STS bit is set.
- 6 **SMI on Software SMI (SW\_SMI\_EN)** ..... def=0  
This bit may be set to trigger an SMI to be generated when the SW\_SMI\_STS bit is set.
- 5 **SMI on BIOS Status (BIOS\_EN)** ..... def=0  
This bit may be set to trigger an SMI to be generated when the BIOS\_STS bit is set.
- 4 **SMI on Legacy USB (LEG\_USB\_EN)**..... def=0  
This bit may be set to trigger an SMI to be generated when the LEG\_USB\_STS bit is set.
- 3 **SMI on GP1 Timer Time Out (GP1TO\_EN)** . def=0  
This bit may be set to trigger an SMI to be generated when the GP1TO\_STS bit is set.
- 2 **SMI on GP0 Timer Time Out (GP0TO\_EN)** . def=0  
This bit may be set to trigger an SMI to be generated when the GP0TO\_STS bit is set.
- 1 **SMI on Secondary Event Timer Time Out (STTO\_EN)** ..... def=0  
This bit may be set to trigger an SMI to be generated when the STTO\_STS bit is set.
- 0 **SMI on Primary Activity (PACT\_EN)** ..... def=0  
This bit may be set to trigger an SMI to be generated when the PACT\_STS bit is set.

Note that SMI can be generated based on the setting of any of the above bits (see the offset 2Ah Global Enable register bit descriptions in the right hand column of this page).

The bits in this register are set by hardware only and can only be cleared by writing a one to the desired bit position.

**I/O Offset 2D-2C - Global Control (GBL\_CTL) .....RW**

- 15-12 **Reserved** ..... always reads 0
- 11 **IDE Secondary Bus Power-Off**  
     0 Disable .....default  
     1 Enable
- 10 **IDE Primary Bus Power-Off**  
     0 Disable .....default  
     1 Enable
- 9 **Reserved** ..... always reads 0
- 8 **SMI Active (INSMI)**  
     0 SMI Inactive.....default  
     1 SMI Active. If the SMIIG bit is set, this bit needs to be written with a 1 to clear it before the next SMI can be generated.
- 7 **LID Triggering Polarity**  
     0 Rising Edge .....default  
     1 Falling Edge
- 6 **THRM# Triggering Polarity**  
     0 Rising Edge .....default  
     1 Falling Edge
- 5 **Battery Low Resume Disable**  
     0 Enable resume .....default  
     1 Disable resume from suspend when BATLOW# is asserted
- 4 **SMI Lock (SMIIG)**  
     0 Disable SMI Lock  
     1 Enable SMI Lock (SMI low to gate for the next SMI) .....default
- 3 **Wait for Halt / Stop Grant Cycle for CPUTP# Assertion**  
     0 Don't wait.....default  
     1 Wait  
     This bit works with Rx4C[7] of PCI configuration space to control the start of CPUTP# assertion.
- 2 **Power Button Triggering Select**  
     0 SCI/SMI generated by PWRBTN# rising edge .....default  
     1 SCI/SMI generated by PWRBTN# low level  
     Set to zero to avoid the situation where PB\_STS is set to wake up the system then reset again by PBOR\_STS to switch the system into the soft-off state.
- 1 **BIOS Release (BIOS\_RLS)**  
     This bit is set by legacy software to indicate release of the SCI/SMI lock. Upon setting of this bit, hardware automatically sets the GBL\_STS bit. This bit is cleared by hardware when the GBL\_STS bit cleared by software.  
     Note that if the GBL\_EN bit is set (bit-5 of the Power Management Enable register at offset 2), then setting this bit causes an SCI to be generated (because setting this bit causes the GBL\_STS bit to be set).
- 0 **SMI Enable (SMI\_EN)**  
     0 Disable all SMI generation.....default  
     1 Enable SMI generation

**I/O Offset 2F - SMI Command (SMI\_CMD) ..... RW**

- 7-0 **SMI Command**  
     Writing to this port sets the SW\_SMI\_STS bit. Note that if the SW\_SMI\_EN bit is set (see bit-6 of the Global Enable register at offset 2Ah), then an SMI is generated.



**I/O Offset 33-30 - Primary Activity Detect Status.....RWC**

These bits correspond to the Primary Activity Detect Enable bits in offset 37-34. All bits default to 0, are set by hardware only, and may only be cleared by writing 1s to the desired bit.

- 31-11 Reserved** .....always read 0
- 10 Audio Access Status** ..... (**AUD\_STS**)  
Set if Audio is accessed.
- 9 Keyboard Controller Access Status**..... (**KBC\_STS**)  
Set if the KBC is accessed via I/O port 60h.
- 8 VGA Access Status**..... (**VGA\_STS**)  
Set if the VGA port is accessed via I/O ports 3B0-3DFh or memory space A0000-BFFFFh.
- 7 Parallel Port Access Status**..... (**LPT\_STS**)  
Set if the parallel port is accessed via I/O ports 278-27Fh or 378-37Fh (LPT2 or LPT1).
- 6 Serial Port B Access Status** ..... (**COMB\_STS**)  
Set if the serial port is accessed via I/O ports 2F8-2FFh or 2E8-2EFh (COM2 and COM4 respectively).
- 5 Serial Port A Access Status** ..... (**COMA\_STS**)  
Set if the serial port is accessed via I/O ports 3F8-3FFh or 3E8-3EFh (COM1 and COM3, respectively).
- 4 Floppy Access Status**..... (**FDC\_STS**)  
Set if the floppy controller is accessed via I/O ports 3F0-3F5h or 3F7h.
- 3 Secondary IDE Access Status**..... (**SIDE\_STS**)  
Set if the IDE controller is accessed via I/O ports 170-177h or 376h.
- 2 Primary IDE Access Status** ..... (**PIDE\_STS**)  
Set if the IDE controller is accessed via I/O ports 1F0-1F7h or 3F6h.
- 1 Primary Interrupt Activity Status**..... (**PIRQ\_STS**)  
Set on the occurrence of a primary interrupt (enabled via the "Primary Interrupt Channel" register at Function 4 PCI configuration register offset 44h).
- 0 PCI Master Access Status** ..... (**DRQ\_STS**)  
Set on the occurrence of PCI master activity.

**I/O Offset 37-34 - Primary Activity Detect Enable..... RW**

These bits correspond to the Primary Activity Detect Status bits in offset 33-30. Setting of any of these bits also sets the PACT\_STS bit (bit-0 of offset 28) which causes the GP0 timer to be reloaded (if PACT\_GP0\_EN is set) or generates an SMI (if PACT\_EN is set).

- 31-11 Reserved** ..... always read 0
- 10 SMI on Audio Status** ..... (**KBC\_EN**)  
0 Don't set PACT\_STS if AUD\_STS is set .... def  
1 Set PACT\_STS if AUD\_STS is set
- 9 SMI on Keyboard Controller Status**..... (**KBC\_EN**)  
0 Don't set PACT\_STS if KBC\_STS is set..... def  
1 Set PACT\_STS if KBC\_STS is set
- 8 SMI on VGA Status**..... (**VGA\_EN**)  
0 Don't set PACT\_STS if VGA\_STS is set .... def  
1 Set PACT\_STS if VGA\_STS is set
- 7 SMI on Parallel Port Status**..... (**LPT\_EN**)  
0 Don't set PACT\_STS if LPT\_STS is set..... def  
1 Set PACT\_STS if LPT\_STS is set
- 6 SMI on Serial Port B Status** ..... (**COMB\_EN**)  
0 Don't set PACT\_STS if COMB\_STS is set . def  
1 Set PACT\_STS if COMB\_STS is set
- 5 SMI on Serial Port A Status** ..... (**COMA\_EN**)  
0 Don't set PACT\_STS if COMA\_STS is set . def  
1 Set PACT\_STS if COMA\_STS is set
- 4 SMI on Floppy Status** ..... (**FDC\_EN**)  
0 Don't set PACT\_STS if FDC\_STS is set ..... def  
1 Set PACT\_STS if FDC\_STS is set
- 3 SMI on Secondary IDE Status**..... (**SIDE\_EN**)  
0 Don't set PACT\_STS if SIDE\_STS is set .... def  
1 Set PACT\_STS if SIDE\_STS is set
- 2 SMI on Primary IDE Status** ..... (**PIDE\_EN**)  
0 Don't set PACT\_STS if PIDE\_STS is set .... def  
1 Set PACT\_STS if PIDE\_STS is set
- 1 SMI on Primary INTR Status** ..... (**PIRQ\_EN**)  
0 Don't set PACT\_STS if PIRQ\_STS is set .... def  
1 Set PACT\_STS if PIRQ\_STS is set
- 0 SMI on PCI Master Status** ..... (**DRQ\_EN**)  
0 Don't set PACT\_STS if DRQ\_STS is set .... def  
1 Set PACT\_STS if DRQ\_STS is set

Note: The bits above correspond to the bits of the Primary Activity Detect Enable register at offset 34 (see right hand column of this page): if the corresponding bit is set in that register, setting of the above bits will cause the PACT\_STS bit to be set (bit-0 of the Global Status register at offset 28). Setting of PACT\_STS may be set up to enable a "Primary Activity Event": an SMI will be generated if PACT\_EN is set (bit-0 of the Global Enable register at offset 2Ah) and/or the GP0 timer will be reloaded if the "GP0 Timer Reload on Primary Activity" bit is set (bit-0 of the GP Timer Reload Enable register at offset 38 on this page).

Note: Bits 2-9 above also correspond to bits of the GP Timer Reload Enable register (see offset 38 on next page): If bits are set in that register, setting a corresponding bit in this register will cause the GP1 timer to be reloaded.



**I/O Offset 3B-38 - GP Timer Reload Enable .....RW**

All bits in this register default to 0 on power up.

**31-8 Reserved** .....always read 0

**7 GP1 Timer Reload on KBC Access**

- 0 Normal GP1 Timer Operation.....default
- 1 Setting of KBC\_STS causes the GP1 timer to reload.

**6 GP1 Timer Reload on Serial Port Access**

- 0 Normal GP1 Timer Operation .....default
- 1 Setting of COMA\_STS or COMB\_STS causes the GP1 timer to reload.

**5 Reserved** .....always read 0

**4 GP1 Timer Reload on VGA Access**

- 0 Normal GP1 Timer Operation .....default
- 1 Setting of VGA\_STS causes the GP1 timer to reload.

**3 GP1 Timer Reload on IDE/Floppy Access**

- 0 Normal GP1 Timer Operation .....default
- 1 Setting of FDC\_STS, SIDE\_STS, or PIDE\_STS causes the GP1 timer to reload.

**2 GP3 Timer Reload on GPIO Range 1 Access**

- 0 Normal GP3 Timer Operation .....default
- 1 Setting of GR1\_STS causes the GP3 timer to reload.

**1 GP2 Timer Reload on GPIO Range 0 Access**

- 0 Normal GP2 Timer Operation .....default
- 1 Setting of GR0\_STS causes the GP2 timer to reload.

**0 GP0 Timer Reload on Primary Activity**

- 0 Normal GP0 Timer Operation .....default
- 1 Setting of PACT\_STS causes the GP0 timer to reload. Primary activities are enabled via the Primary Activity Detect Enable register (offset 37-34) with status recorded in the Primary Activity Detect Status register (offset 33-30).

**I/O Offset 40 – Extended I/O Trap Status ..... RWC**

**7-2 Reserved** ..... always read 0

**1 GPIO Range 3 Access Status..... (GPR3\_STS)**

**0 GPIO Range 2 Access Status..... (GPR2\_STS)**

**I/O Offset 42 – Extended I/O Trap Enable..... RW**

**7-2 Reserved** ..... always read 0

**1 SMI on GPIO Range 3 Access.....(GPR3\_EN)**

0 Disable..... default

1 Enable

**0 SMI on GPIO Range 2 Access.....(GPR2\_EN)**

0 Disable..... default

1 Enable

## General Purpose I/O Registers

### I/O Offset 44 – External SMI / GPI Input Value.....RO

Depending on the configuration, up to 8 external SCI/SMI ports are available as indicated below. The state of these inputs may be read in this register.

- 7 RING# Input Value..... (GPI7 pin)
- 6 SMBALRT# Input Value ..... (GPI6 pin)
- 5 PME# Input Value ..... (GPI5 pin)
- 4 SLPBTN# Input Value..... (GPI4 pin)
- 3 General Purpose Input 17 Value ..... (GPI17 pin)
- 2 General Purpose Input 16 Value ..... (GPI16 pin)
- 1 General Purpose Input 1 Value ..... (GPI1 pin)
- 0 EXTSMI# Input Value

### I/O Offset 45 – SMI / IRQ / Resume Status .....RO

- 7-5 Reserved ..... always reads 0
- 4 Latest PCSn Status
  - 0 Latest PCSn was an I/O Read
  - 1 Latest PCSn was an I/O Write
- 3 FM SMI or Serial SMI Status
- 2 Hardware Monitor IRQ Status
- 1 SMBus IRQ Status
- 0 SMBus Resume Status

### I/O Offset 4B-48 - GPI Port Input Value (GPIVAL)..... RO

- 31-24 Reserved ..... always read 0
- 23-16 GPI[23-16] by Refresh Scan ..... Read Only
- 15-12 Reserved ..... always read 0
- 11-0 GPI[11-0] Input Value ..... Read Only

### I/O Offset 4F-4C - GPO Port Output Value (GPOVAL)RW

Reads from this register return the last value written (held on chip)

- 31-26 Reserved ..... always reads 0
- 25-0 GPO[25-0] Output Value ..... def = 3FFFFFFh

## System Management Bus I/O-Space Registers

The base address for these registers is defined in Rx93-90 of the Function 4 PCI configuration registers. The System Management Bus I/O space is enabled for access by the system if RxD2[0] = 1.

### I/O Offset 00 – SMBus Host Status.....RWC

- 7-5 **Reserved** ..... always reads 0
- 4 **Failed Bus Transaction.....RWC**
  - 0 SMBus interrupt not caused by failed bus transaction .....default
  - 1 SMBus interrupt caused by failed bus transaction. This bit may be set when the KILL bit (I/O Rx02[1]) is set and can be cleared by writing a 1 to this bit position.
- 3 **Bus Collision.....RWC**
  - 0 SMBus interrupt not caused by transaction collision.....default
  - 1 SMBus interrupt caused by transaction collision. This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 2 **Device Error.....RWC**
  - 0 SMBus interrupt not caused by generation of an SMBus transaction error .....default
  - 1 SMBus interrupt caused by generation of an SMBus transaction error (illegal command field, unclaimed host-initiated cycle, or host device timeout). This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 1 **SMBus Interrupt.....RWC**
  - 0 SMBus interrupt not caused by host command completion.....default
  - 1 SMBus interrupt caused by host command completion. This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 0 **Host Busy .....RO**
  - 0 SMBus controller host interface is not processing a command .....default
  - 1 SMBus host controller is busy processing a command. None of the other SMBus registers should be accessed if this bit is set.

### I/O Offset 01h – SMBus Slave Status.....RWC

- 7-6 **Reserved** ..... always reads 0
- 5 **Alert Status .....RWC**
  - 0 SMBus interrupt not caused by SMBALERT# signal ..... default
  - 1 SMBus interrupt caused by SMBALERT# signal. This bit will be set only if the Alert Enable bit is set in the SMBus Slave Control Register at I/O Offset R08[3]. This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 4 **Shadow 2 Status.....RWC**
  - 0 SMBus interrupt not caused by address match to SMBus Shadow Address Port 2..... default
  - 1 SMBus interrupt or resume event caused by slave cycle address match to SMBus Shadow Address Port 2. This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 3 **Shadow 1 Status.....RWC**
  - 0 SMBus interrupt not caused by address match to SMBus Shadow Address Port 1..... default
  - 1 SMBus interrupt or resume event caused by slave cycle address match to SMBus Shadow Address Port 1. This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 2 **Slave Status .....RWC**
  - 0 SMBus interrupt not caused by slave event match ..... default
  - 1 SMBus interrupt or resume event caused by slave cycle event match of the SMBus Slave Command Register at PCI Function 4 Configuration Offset D3h (command match) and the SMBus Slave Event Register at SMBus Base + Offset 0Ah (data event match). This bit is only set by hardware and can be cleared by writing a 1 to this bit position.
- 1 **Reserved** ..... always reads 0
- 0 **Slave Busy .....RO**
  - 0 SMBus controller slave interface is not processing data ..... default
  - 1 SMBus controller slave interface is busy receiving data. None of the other SMBus registers should be accessed if this bit is set.

**I/O Offset 02h – SMBus Host Control.....RW**

- 7 **Reserved** ..... always reads 0
- 6 **Start** ..... always reads 0
  - 0 Writing 0 has no effect .....default
  - 1 Start Execution of Command  
Writing a 1 to this bit causes the SMBus controller host interface to initiate execution of the command programmed in the SMBus Command Protocol field (bits 4-2). All necessary registers should be programmed prior to writing a 1 to this bit. The Host Busy bit (SMBus Host Status Register bit-0) can be used to identify when the SMBus controller has completed command execution.
- 5 **Reserved** ..... always reads 0
- 4-2 **SMBus Command Protocol**
  - 000 Quick Read or Write .....default
  - 001 Byte Read or Write
  - 010 Byte Data Read or Write
  - 011 Word Data Read or Write
  - 100 Reserved
  - 101 Block Read or Write
  - 110 Reserved
  - 111 Reserved
- 1 **Kill Transaction in Progress**
  - 0 Normal host controller operation .....default
  - 1 Stop host transaction currently in progress.  
Setting this bit also sets the FAILED status bit (Host Status bit-4) and asserts the interrupt selected by the SMB Interrupt Select bit (Function 4 SMBus Host Configuration Register RxD2[3]).
- 0 **Interrupt Enable**
  - 0 Disable interrupt generation .....default
  - 1 Enable generation of interrupts on completion of the current host transaction.

**I/O Offset 03h – SMBus Host Command..... RW**

- 7-0 **SMBUS Host Command** ..... default = 0  
This field contains the data transmitted in the command field of the SMBus host transaction.

**I/O Offset 04h – SMBus Host Address..... RW**

The contents of this register are transmitted in the address field of the SMBus host transaction.

- 7-1 **SMBUS Address** ..... default = 0  
This field contains the 7-bit address of the targeted slave device.
- 0 **SMBUS Read or Write**
  - 0 Execute a WRITE command ..... default
  - 1 Execute a READ command

**I/O Offset 05h – SMBus Host Data 0 ..... RW**

The contents of this register are transmitted in the Data 0 field of SMBus host transaction writes. On reads, Data 0 bytes are stored here.

- 7-0 **SMBUS Data 0** ..... default = 0  
For Block Write commands, this field is programmed with the block transfer count (a value between 1 and 32). Counts of 0 or greater than 32 are undefined. For Block Read commands, the count received from the SMBus device is stored here.

**I/O Offset 06h – SMBus Host Data 1 ..... RW**

The contents of this register are transmitted in the Data 1 field of SMBus host transaction writes. On reads, Data 1 bytes are stored here.

- 7-0 **SMBUS Data 1** ..... default = 0

**I/O Offset 07h – SMBus Block Data ..... RW**

Reads and writes to this register are used to access the 32-byte block data storage array. An internal index pointer is used to address the array. It is reset to 0 by reads of the SMBus Host Control register (I/O Offset 2) and incremented automatically by each access to this register. The transfer of block data into (read) or out of (write) this storage array during an SMBus transaction always starts at index address 0.

- 7-0 **SMBUS Block Data** ..... default = 0

**I/O Offset 08h – SMBus Slave Control.....RW**

- 7-4 **Reserved** ..... always reads 0
- 3 **SMBus Alert Enable**
- 0 Disable .....default
  - 1 Enable generation of an interrupt or resume event on the assertion of the SMBALERT# signal
- 2 **SMBus Shadow Port 2 Enable**
- 0 Disable .....default
  - 1 Enable generation of an interrupt or resume event on external SMBus master generation of a transaction with an address that matches the SMBus Slave Shadow Port 2 register (PCI function 4 configuration register RxD5).
- 1 **SMBus Shadow Port 1 Enable**
- 0 Disable .....default
  - 1 Enable generation of an interrupt or resume event on external SMBus master generation of a transaction with an address that matches the SMBus Slave Shadow Port 1 register (PCI function 4 configuration register RxD4).
- 0 **SMBus Slave Enable**
- 0 Disable .....default
  - 1 Enable generation of an interrupt or resume event on external SMBus master generation of a transaction with an address that matches the SMBus host controller slave port of 10h, a command field which matches the SMBus Slave Command register (PCI function 4 configuration register RxD3), and a match of one of the corresponding enabled events in the SMBus Slave Event Register (I/O Offset 0Ah).

**I/O Offset 09h – SMBus Shadow Command ..... RO**

This register is used to store command values for external SMBus master accesses to the host slave and slave shadow ports.

- 7-0 **Shadow Command**.....default = 0
- This field contains the command value which was received during an external SMBus master access whose address field matched the host slave address (10h) or one of the slave shadow port addresses.

**I/O Offset 0Ah – SMBus Slave Event ..... RW**

This register is used to enable generation of interrupt or resume events for accesses to the host controller's slave port.

- 15-0 **SMBus Slave Event** .....default = 0
- This field contains data bits used to compare against incoming data to the SMBus Slave Data Register (I/O Offset 0Ch). When a bit in this register is set and the corresponding bit the Slave Data register is also set, an interrupt or resume event will be generated if the command value matches the value in the SMBus Slave Command register and the access was to SMBus host address 10h.

**I/O Offset 0Ch – SMBus Slave Data ..... RO**

This register is used to store data values for external SMBus master accesses to the shadow ports or the SMBus host controller's slave port.

- 15-0 **SMBus Slave Data** .....default = 0
- This field contains the data value which was transmitted during an external SMBus master access whose address field matched one of the slave shadow port addresses or the SMBus host controller slave port address of 10h.

## **Hardware Monitor I/O Space Registers**

The I/O base address for access to the Hardware Monitor registers is defined in Rx71-70 of function 4 PCI configuration space. The hardware monitor I/O space is enabled for I/O access by the system if Rx74[0] = 1.

**Offset 13 – Analog Data 15-8 .....RW**

**Offset 14 – Analog Data 7-0 .....RW**

**Offset 15 – Digital Data 7-0 .....RW**

**Offset 16 – Channel Counter.....RW**

**Offset 17 – Data Valid & Channel Indicators.....RW**

**Offset 1D – TSENS3 Hot Temperature High Limit .....RW**

**Offset 1E – TSENS3 Hot Temp Hysteresis Lo Limit.....RW**

**Offset 1F – TSENS3 Temperature Reading.....RW**

Temperature sensor 3 is an internal bandgap-type sensor which has 10-bit resolution. The high order 8 bits are stored here and the low order 2 bits are stored in Rx49[7-6]. Only the high order 8 bits are used for comparison with the limit values in offsets 1D and 1E.

**Offset 20 – TSENS1 Temperature Reading .....RW**

Temperature sensor 1 is an external sensor input on pin W13 which has 10-bit resolution. The high order 8 bits are stored here and the low order 2 bits are stored in Rx4B[7-6]. Only the high order 8 bits are used for comparison with the limit values in offsets 39 and 3A.

**Offset 21 – TSENS2 Temperature Reading .....RW**

Temperature sensor 2 is an external sensor input on pin Y13 which has 10-bit resolution. The high order 8 bits are stored here and the low order 2 bits are stored in Rx49[5-4]. Only the high order 8 bits are used for comparison with the limit values in offsets 3D and 3E.

**Offset 22 – VSENS1 (Pin U13) Voltage Reading (2.0V).RW**

**Offset 23 – VSENS2 (Pin V13) Voltage Reading (2.5V).RW**

**Offset 24 – Internal Core Voltage Reading (3.3V) .....RW**

**Offset 25 – VSENS3 (Pin W14) Voltage Reading (5V) ..RW**

**Offset 26 – VSENS4 (Pin Y14) Voltage Reading (12V)..RW**

**Offset 27 – Reserved (-12V Sense Voltage Reading).....RW**

**Offset 28 – Reserved (-5V Sense Voltage Reading).....RW**

**Offset 29 – FAN1 (Pin T12) Count Reading..... RW**

**Offset 2A – FAN2 (Pin U12) Count Reading..... RW**

The above two locations store the number of counts of the internal clock per fan revolution.

**Offset 2B – VSENS1 Voltage High Limit (CPU 2.0V)... RW**

**Offset 2C – VSENS1 Voltage Low Limit (CPU 2.0V) ... RW**

**Offset 2D – VSENS2 Voltage High Limit (NB 2.5V) ..... RW**

**Offset 2E – VSENS2 Voltage Low Limit (NB 2.5V) ..... RW**

**Offset 2F – Internal Core Voltage High Limit (3.3V).... RW**

**Offset 30 – Internal Core Voltage Low Limit (3.3V)..... RW**

**Offset 31 – VSENS3 Voltage High Limit (5V)..... RW**

**Offset 32 – VSENS3 Voltage Low Limit (5V) ..... RW**

**Offset 33 – VSENS4 Voltage High Limit (12V)..... RW**

**Offset 34 – VSENS4 Voltage Low Limit (12V) ..... RW**

**Offset 35 – Reserved (-12V Sense High Limit) ..... RW**

**Offset 36 – Reserved (-12V Sense Low Limit)..... RW**

**Offset 37 – Reserved (-5V Sense High Limit)..... RW**

**Offset 38 – Reserved (-5V Sense Low Limit)..... RW**

**Offset 39 – TSENS1 Hot Temperature High Limit..... RW**

**Offset 3A – TSENS1 Hot Temp Hysteresis Lo Limit..... RW**

**Offset 3B – FAN1 Fan Count Limit ..... RW**

**Offset 3C – FAN2 Fan Count Limit ..... RW**

The above two locations store the number of counts of the internal clock per fan revolution for the low limit of the fan speed.

**Offset 3D – TSENS2 Hot Temperature High Limit..... RW**

**Offset 3E – TSENS2 Hot Temp Hysteresis Lo Limit..... RW**

**Offset 3F – Stepping ID Number ..... RW**

Note: For high limits, comparisons are “greater than” comparisons. For low limits, comparisons are “less than or equal” comparisons.

One consequence of the above is that if high limits are set to all ones (FFh or 1111111b), interrupts are disabled for high limits (i.e., interrupts will only be generated for cases when voltages are equal to or below the low limits).

**Offset 40 –Hardware Monitor Configuration .....RW**

- 7 Initialization**
  - 0 Normal operation .....default
  - 1 Restore power-up default values to this register, the interrupt status and mask registers, the FAN/RST#/OS# register, and the OS# Configuration / Temperature Resolution register. This bit automatically clears itself since the power-on default is 0.
- 6 Chassis Intrusion Reset**
  - 0 Normal operation .....default
  - 1 Reset the Chassis Intrusion pin
- 5-4 Reserved (R/W) ..... default = 0**
- 3 Hardware Monitor Interrupt Clear**
  - 0 Normal operation
  - 1 Clear the hardware monitor interrupt output (does not effect the contents of the interrupt status register). Normally set during interrupt service .....default
- 2 Reserved ..... always reads 0**
- 1 Hardware Monitor Interrupt Enable**
  - 0 Disable hardware monitor interrupt output.. def
  - 1 Enable hardware monitor interrupt output
- 0 Start**
  - 0 Place hardware monitor in standby mode.... def
  - 1 Enable startup of hardware monitor logic.  
At startup, limit checking functions and scanning begins. All high and low limits should be set prior to turning on this bit. Note: the hardware monitor interrupt output will not be cleared if the user writes a zero to this bit after an interrupt has occurred (the hardware monitor interrupt clear bit must be used for this purpose).



**Offset 41 –Hardware Monitor Interrupt Status 1.....RO**

- 7 **Fan 2 Error**
  - 0 No error.....default
  - 1 Fan 2 count limit exceeded
- 6 **Fan 1 Error**
  - 0 No error.....default
  - 1 Fan 1 count limit exceeded
- 5 **Reserved** ..... always reads 0
- 4 **TSENS1 Temperature Error**
  - 0 No error.....default
  - 1 High or low hot temperature limit exceeded.  
The interrupt mode is determined by  
Temperature Resolution register Rx4B[1-0].
- 3 **VSENS3 Voltage Error (5V)**
  - 0 No error.....default
  - 1 High or low limit exceeded
- 2 **Internal Core VCC Voltage Error (3.3V)**
  - 0 No error.....default
  - 1 High or low limit exceeded
- 1 **VSENS2 Voltage Error (2.5V NB Core Voltage)**
  - 0 No error.....default
  - 1 High or low limit exceeded
- 0 **VSENS1 Voltage Error (2.0V CPU Core Voltage)**
  - 0 No error.....default
  - 1 High or low limit exceeded

**Offset 42 –Hardware Monitor Interrupt Status 2.....RO**

- 7 **TSENS3 (Internal Bandgap) Temp Error**
  - 0 No error.....default
  - 1 High or low hot temperature limit exceeded.  
Interrupt mode is determined by Rx4B[5-4].
- 6-5 **Reserved** ..... always reads 0
- 4 **Chassis Error**
  - 0 No error.....default
  - 1 Chassis Intrusion has gone high
- 3 **TSENS2 Temperature Error**
  - 0 No error.....default
  - 1 High or low hot temperature limit exceeded.  
Interrupt mode is determined by Rx4B[3-2].
- 2-1 **Reserved** ..... always reads 0
- 0 **VSENS4 Voltage Error (12V)**
  - 0 No error.....default
  - 1 High or low limit exceeded

Note: When either status register is read, status conditions in that register are reset. In the case of voltage priority indications, if two or more voltages were out of limits, then another indication would automatically be generated if it was not handled during interrupt service. Errant voltages may be disabled in the control register until the operator has time to clear the errant condition or set the limit higher or lower.

**Offset 43 –Hardware Monitor Interrupt Mask 1 ..... RW**

- 7 **Fan 2 Count Error Mask**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 6 **Fan 1 Count Error Mask**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 5 **TSENS1 Thermal Alarm Control Mask**
  - 0 Enable TSENS1 over-temp condition to  
control the thermal alarm (function 4 Rx40[7]  
automatic CPU clock throttling must be set) def
  - 1 Disable
- 4 **TSENS1 Temperature Error Mask**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 3 **VSENS3 Voltage Error Mask (5V)**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 2 **Internal Core VCC Voltage Error Mask (3.3V)**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 1 **VSENS2 Voltage Error Mask (2.5V NB Core)**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 0 **VSENS1 Voltage Error Mask (2.0V CPU Core)**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set

**Offset 44 –Hardware Monitor Interrupt Mask 2 ..... RW**

- 7 **TSENS3 Temperature Error Mask**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 6 **TSENS3 Thermal Alarm Control Mask**
  - 0 Enable TSENS3 over-temp condition to  
control the thermal alarm (function 4 Rx40[7]  
automatic CPU clock throttling must be set) def
  - 1 Disable
- 5 **TSENS2 Thermal Alarm Control Mask**
  - 0 Enable TSENS2 over-temp condition to  
control the thermal alarm (function 4 Rx40[7]  
automatic CPU clock throttling must be set) def
  - 1 Disable
- 4 **Chassis Error Mask**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 3 **TSENS2 Temperature Error Mask**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set
- 2-1 **Reserved** ..... always reads 0
- 0 **VSENS4 Voltage Error Mask (12V)**
  - 0 Enable interrupt on error status bit set ..... def
  - 1 Disable interrupt on error status bit set



**Offset 47 –Hardware Monitor Fan Configuration.....RW**

- 7-6 Fan 2 RPM Control**
  - 00 Divide by 1
  - 01 Divide by 2 .....default
  - 10 Divide by 4
  - 11 Divide by 8
- 5-4 Fan 1 RPM Control**
  - 00 Divide by 1
  - 01 Divide by 2 .....default
  - 10 Divide by 4
  - 11 Divide by 8
- 3-0 Reserved** ..... always reads 0

**Offset 49 –Hardware Monitor Temp Low Order ValueRW**

- 7-6 TSENS3 Value Low-Order Bits**  
Upper 8 bits are stored in offset 1Fh
- 5-4 TSENS2 Value Low-Order Bits**  
Upper 8 bits are stored in offset 21h
- 3 Over Temperature Active Low for PMU to Control Stop Clock**
  - 0 Disable .....default
  - 1 Enable
- 2 Chassis Active Low Output 20 msec**
  - 0 Disable .....default
  - 1 Enable
- 1 Interrupt Active High Output**
  - 0 Disable .....default
  - 1 Enable
- 0 Reserved** ..... always reads 0

**Offset 4B –Temperature Interrupt Configuration ..... RW**

- 7-6 TSENS1 Value Low-Order Bits** .....def = 00  
Upper 8 bits are stored in offset 20h
- 5-4 TSENS3 Hot Temp Interrupt Mode** .....def = 01
- 3-2 TSENS2 Hot Temp Interrupt Mode** .....def = 01
- 1-0 TSENS1 Hot Temp Interrupt Mode** .....def = 01  
The following applies to each of the above 3 fields
  - 00 Default Interrupt Mode. An interrupt occurs if the temperature goes above the hot limit. The interrupt will be cleared once the status register is read, but will be generated again when the next conversion is completed. Interrupts will continue to be generated until the temperature goes below the hysteresis limit.
  - 01 One-Time Interrupt Mode. An interrupt is generated if the temperature goes above the hot limit. The interrupt will be cleared when the status register is read. Another interrupt will not be generated until the temperature first drops below the hysteresis limit..... default
  - 10 Comparator mode. An interrupt occurs if the temperature goes above the hot limit. This interrupt remains active until the temperature goes below the hot limit (i.e., no hysteresis).
  - 11 Default Interrupt Mode (same as 00)

## **Function 5 & 6 Registers - AC97 Audio & Modem Codecs**

The codec interface is hardware compatible with AC97 and SoundBlaster Pro. There are two sets of software accessible registers: PCI configuration registers and I/O registers. The PCI configuration registers for the **Audio Codec** are located in the **function 5** PCI configuration space of the VT8231. The PCI configuration registers for the **Modem Codec** are located in the **function 6** PCI configuration space. The I/O registers are located in the system I/O space.

### **PCI Configuration Space Header – Function 5 Audio**

#### **Offset 1-0 - Vendor ID .....RO**

0-7 Vendor ID ..... (1106h = VIA Technologies)

#### **Offset 3-2 - Device ID.....RO**

0-7 Device ID (3058h = VT8231 Audio Codec)

#### **Offset 5-4 - Command.....RW**

15-10 Reserved ..... always reads 0  
 9 Fast Back-to-Back.....fixed at 0  
 8 SERR# Enable.....fixed at 0  
 7 Address Stepping .....fixed at 0  
 6 Parity Error Response.....fixed at 0  
 5 VGA Palette Snoop .....fixed at 0  
 4 Memory Write and Invalidate .....fixed at 0  
 3 Special Cycle Monitoring .....fixed at 0  
 2 Bus Master .....fixed at 0  
 1 Memory Space.....fixed at 0  
 0 I/O Space ..... default=0 (disabled)

#### **Offset 7-6 - Status.....RWC**

15 Detected Parity Error .....fixed at 0  
 14 Signalled System Error.....fixed at 0  
 13 Received Master Abort.....fixed at 0  
 12 Received Target Abort .....fixed at 0  
 11 Signalled Target Abort.....fixed at 0  
 10-9 DEVSEL# Timing  
   00 Fast  
   01 Medium ..... fixed  
   10 Slow  
   11 Reserved  
 8 Data Parity Error.....fixed at 0  
 7 Fast Back-to-Back Capable.....fixed at 0  
 6-5 Reserved ..... always reads 0  
 4 PM 1.1 .....fixed at 1  
 3-0 Reserved ..... always reads 0

#### **Offset 8 - Revision ID (40h) .....RO**

7-0 Silicon Revision Code

#### **Offset 9 - Programming Interface (00h)..... RO**

#### **Offset A - Sub Class Code (01h=Audio Device)..... RO**

#### **Offset B - Base Class Code (04h=Multimedia Device) ..... RO**

#### **Offset D - Latency Timer (00h)..... RO**

#### **Offset E - Header Type (00h)..... RO**

#### **Offset F - BIST (00h) ..... RO**

#### **Offset 13-10 - Base Address 0 – SGD Control / Status.. RW**

31-16 Reserved .....always reads 0  
 15-8 Base Address..... default = 00h  
 7-0 00000001b (256 bytes)

#### **Offset 17-14 - Base Address 1 – FM NMI Status ..... RW**

31-16 Reserved .....always reads 0  
 15-2 Base Address..... default = 0000h  
 1-0 01b (4 bytes)

#### **Offset 1B-18 - Base Address 2 – MIDI Port ..... RW**

31-16 Reserved .....always reads 0  
 15-2 Base Address..... default = 0330h  
 1-0 01b (4 bytes)

#### **Offset 2F-2C – Subsystem ID / Sub Vendor ID..... RO\***

\*This register is RW if function 5-6 Rx42[5] = 1

#### **Offset 34 – Capture Pointer (Default = C0h) ..... RO**

#### **Offset 3C - Interrupt Line..... RW**

7-4 Reserved .....always reads 0  
 3-0 Audio Interrupt Routing  
   0000 Disabled ..... default  
   0001 IRQ1  
   0010 Reserved  
   0011 IRQ3  
   0100 IRQ4  
   0101 IRQ5  
   0110 IRQ6  
   0111 IRQ7  
   1000 IRQ8  
   1001 IRQ9  
   1010 IRQ10  
   1011 IRQ11  
   1100 IRQ12  
   1101 IRQ13  
   1110 IRQ14  
   1111 Disabled

#### **Offset 3D - Interrupt Pin (03h)..... RO**

#### **Offset 3E - Minimum Grant (00h)..... RO**

#### **Offset 3F - Maximum Latency (00h)..... RO**

**PCI Configuration Space Header – Function 6 Modem**
**Offset 1-0 - Vendor ID .....RO**

0-7 Vendor ID ..... (1106h = VIA Technologies)

**Offset 3-2 - Device ID.....RO**

0-7 Device ID (3068h = 8231 Modem Codec)

**Offset 5-4 - Command.....RW**

15-10 Reserved ..... always reads 0  
 9 Fast Back-to-Back.....fixed at 0  
 8 SERR# Enable.....fixed at 0  
 7 Address Stepping .....fixed at 0  
 6 Parity Error Response.....fixed at 0  
 5 VGA Palette Snoop .....fixed at 0  
 4 Memory Write and Invalidate .....fixed at 0  
 3 Special Cycle Monitoring .....fixed at 0  
 2 Bus Master .....fixed at 0  
 1 Memory Space.....fixed at 0  
 0 I/O Space ..... default=0 (disabled)

**Offset 7-6 - Status.....RWC**

15 Detected Parity Error.....fixed at 0  
 14 Signalled System Error.....fixed at 0  
 13 Received Master Abort.....fixed at 0  
 12 Received Target Abort .....fixed at 0  
 11 Signalled Target Abort.....fixed at 0  
 10-9 DEVSEL# Timing  
     00 Fast  
     01 Medium ..... fixed  
     10 Slow  
     11 Reserved  
 8 Data Parity Error.....fixed at 0  
 7 Fast Back-to-Back Capable.....fixed at 0  
 6-0 Reserved ..... always reads 0

**Offset 8 - Revision ID (nnh) .....RO**

7-0 Silicon Revision Code (0 indicates first silicon)

**Offset 9 - Programming Interface (00h) .....\*RO**
**Offset A - Sub Class Code (80h).....\*RO**
**Offset B - Base Class Code (07h).....\*RO**

\*Registers 9-B are RW if function 5-6 Rx44[5] = 1

**Offset D - Latency Timer (00h) .....RO**
**Offset E - Header Type (00h) .....RO**
**Offset F - BIST (00h).....RO**
**Offset 13-10 - Base Address 0 – SGD Control / Status.. RW**

31-16 Reserved .....always reads 0  
 15-8 Base Address..... default = 00h  
 7-0 00000001b (256 bytes)

**Offset 1F-1C - Base Address 3 – Codec Reg Shadow .... RW**

31-16 Reserved .....always reads 0  
 15-8 Base Address..... default = 00h  
 7-0 00000001b (256 bytes)

**Offset 3C - Interrupt Line..... RW**

7-4 Reserved .....always reads 0  
 3-0 Audio Interrupt Routing  
     0000 Disabled..... default  
     0001 IRQ1  
     0010 Reserved  
     0011 IRQ3  
     0100 IRQ4  
     0101 IRQ5  
     0110 IRQ6  
     0111 IRQ7  
     1000 IRQ8  
     1001 IRQ9  
     1010 IRQ10  
     1011 IRQ11  
     1100 IRQ12  
     1101 IRQ13  
     1110 IRQ14  
     1111 Disabled

**Offset 3D - Interrupt Pin (03h)..... RO**
**Offset 3E - Minimum Grant (00h)..... RO**
**Offset 3F - Maximum Latency (00h) ..... RO**

**Function 5 & 6 Codec-Specific Configuration Registers**
**Offset 40 – AC97 Interface Status .....RO**

- 7-5 **Reserved** ..... always reads 0
- 4 **AC97 Codec Low-Power Status.....RO**
  - 0 AC97 Codec not in low-power mode
  - 1 AC97 Codec in low-power mode
- 3 **Reserved** ..... always reads 0
- 2 **Secondary Codec 2 (CID=10b) Ready Status ....RO**
  - 0 Codec Not Ready
  - 1 Codec Ready (AC97 ctrlr can access codec)
- 1 **Secondary Codec 1 (CID=01b) Ready Status ....RO**
  - 0 Codec Not Ready
  - 1 Codec Ready (AC97 ctrlr can access codec)
- 0 **Primary Codec Ready Status .....RO**
  - 0 Codec Not Ready
  - 1 Codec Ready (AC97 ctrlr can access codec)

**Offset 41 – AC Link Interface Control ..... RW**

- 7 **AC-Link Interface Enable (ENAC97)**
  - 0 Disable..... default
  - 1 Enable
- 6 **AC-Link Reset (ACRST#)**
  - 0 Assert AC-Link Reset ..... default
  - 1 De-assert AC-Link Reset
- 5 **AC-Link Sync (RSYNCHI)**
  - 0 Release SYNC ..... default
  - 1 Force SYNC High
- 4 **AC-Link Serial Data Out**
  - 0 Release SDO ..... default
  - 1 Force SDO High

**Function 5 Only (Reserved in Function 6):**

- 3 **Variable-Sample-Rate On-Demand Mode**
  - 0 Disable..... default
  - 1 Enable

Bit valid in function 5 only (reserved in function 6)
- 2 **AC Link SGD Read Channel PCM Data Output**
  - 0 Disable..... default
  - 1 Enable

Bit valid in function 5 only (reserved in function 6)
- 1 **AC Link FM Channel PCM Data Out (SELFM)**
  - 0 Disable..... default
  - 1 Enable

Bit valid in function 5 only (reserved in function 6)
- 0 **AC Link SB PCM Data Output (SELSB)**
  - 0 Disable..... default
  - 1 Enable

Bit valid in function 5 only (reserved in function 6)

**Offset 42 – Function Enable .....RW (Function 5)**
**Offset 42 – Function Enable .....RO (Function 6)**

- 7 MIDI PnP**
  - 0 MIDI Port Address Selected by Rx43[3-2]. def
  - 1 MIDI Port Address Selected by IOBase2
- 6 Mask MIDI IRQ**
  - 0 Disable .....default
  - 1 Enable
- 5 Function 5 Config Reg Rx2C Writable**
  - 0 F5Rx2C-2F RO .....default
  - 1 F5Rx2C-2F RW
- 4 Gate SoundBlaster PCM When FIFO Empty**
  - 0 Disable .....default
  - 1 Enable
- 3 Game Port Enable (ENGAME)**
  - 0 Disable .....default
  - 1 Enable (200-207h)
- 2 FM Enable (ENFM)**
  - 0 Disable .....default
  - 1 Enable (388-38B)
- 1 MIDI Enable (ENMIDI)**
  - 0 Disable .....default
  - 1 Enable
- 0 SoundBlaster Enable (ENSB)**
  - 0 Disable .....default
  - 1 Enable

**Offset 43 – Plug and Play Control .....RW (Function 5)**
**Offset 43 – Plug and Play Control .....RO (Function 6)**

- 7-6 SoundBlaster IRQ Select (SBIRQS[1:0])**
  - 00 IRQ5 .....default
  - 01 IRQ7
  - 10 IRQ9
  - 11 IRQ10
- 5-4 SoundBlaster DRQ Select (SBDQRS[1:0])**
  - 00 DMA Channel 0
  - 01 DMA Channel 1 .....default
  - 10 DMA Channel 2
  - 11 DMA Channel 3
- 3-2 MIDI Decode Select (MIDIBASE)**
  - 00 300-303h
  - 01 310-313h
  - 10 320-323h
  - 11 330-333h .....default
- 1-0 SoundBlaster Decode Select (SBBASE)**
  - 00 220-22Fh .....default
  - 01 240-24Fh
  - 10 260-26Fh
  - 11 280-28Fh

**Offset 44 – MC97 Interface Control ..... RO (Function 5)**
**Offset 44 – MC97 Interface Control ..... RW (Function 6)**

- 7 Function 5 AC-Link Interface Access**
  - 0 Disable..... default
  - 1 Enable
- 6 Secondary Codec Support**
  - 0 Disable..... default
  - 1 Enable
- 5 Function 6 Config Reg Rx9-B Writable**
  - 0 F6Rx9-B RO ..... default
  - 1 F6Rx9-B RW
- 4 Function 6 Config Reg 2Ch Writable**
  - 0 F6Rx2C-2F RO ..... default
  - 1 F6Rx2C-2F RW
- 3-0 Reserved** .....always reads 0

**Offset 48 – FM NMI Control..... RW (Function 5)**
**Offset 48 – FM NMI Control..... RO (Function 6)**

- 7-3 Reserved** .....always reads 0
- 2 FM IRQ Select**
  - 0 Route FM Trap interrupt to NMI..... default
  - 1 Route FM Trap interrupt to SMI
- 1 FM SGD Data for SoundBlaster Mixing**
  - 0 Disable..... default
  - 1 Enable
- 0 FM Trap Interrupt**
  - 0 Enable..... default
  - 1 Disable

**Offset 4B-4A – Game Port Base Address . RW (Function 5)**
**Offset 4B-4A – Game Port Base Address .. RO (Function 6)**

- 15-0 Game Port Base Address** ..... default = 0

**Function 5 I/O Base 0 Regs – DXSn Scatter/Gather DMA**

“n” is 0-3 for DXS channels 0-3

**I/O Offset n0 – DXSn SGD Read Channel Status .....RWC**

- 7 SGD Active (0 = completed or terminated).....RO
- 6-3 Reserved ..... always reads 0
- 2 SGD Stopped .....RO
- 1 SGD EOL .....RWC
- 0 SGD Flag .....RWC

**I/O Offset n1 – DXSn SGD Read Channel Control.....RW**

- 7 SGD Trigger ..... WO (always reads 0)
  - 0 No effect
  - 1 Trigger SGD Operation
- 6 SGD Terminate ..... WO (always reads 0)
  - 0 No effect
  - 1 Terminate SGD Operation
- 5 Auto Restart
  - 0 Stop SGD Operation at EOL
  - 1 Restart SGD Operation at EOL
- 4 SGD Pause
  - 0 Release SGD pause and resume the transfer from the paused line
  - 1 Pause SGD read operation (SGD pointer stays at the current address)
- 3-2 Reserved ..... always reads 0
- 1 Interrupt on EOL @ End of Block
  - 0 Disable .....default
  - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
  - 0 Disable .....default
  - 1 Enable

**I/O Offset n2 – DXSn Read Channel Left Volume.....RW**

- 7-6 Reserved ..... always reads 0
- 5-0 Left Volume Control
  - 000000 0 db .....default
  - 000111 -10.5 db
  - 011111 -46.5 db.....default
  - 111111 muted (instead of -94.5 db)

**I/O Offset n3 – DXSn Read Channel Right Volume .....RW**

- 7-6 Reserved ..... always reads 0
- 5-0 Right Volume Control
  - 000000 0 db .....default
  - 000111 -10.5 db
  - 011111 -46.5 db.....default
  - 111111 muted (instead of -94.5 db)

**I/O Offset n7-n4 – DXSn SGD Table Pointer Base..... RW**

- 31-0 SGD Table Pointer Base Address (even addr).... W
- Current Pointer Address ..... R

**I/O Offset nB-n8 – DXSn Read Channel Format..... RO**

- 31-24 Stop Index (SGD operation will stop at end of entry)
- 23-22 Reserved .....always reads 0
- 21-20 PCM Format
  - 00 8-Bit Mono Format..... default
  - 01 8-Bit Stereo Format
  - 10 16-bit Mono Format..... default
  - 11 16-bit Stereo Format

**19-0 DXSx Channel Sample Rate**
**I/O Offset nF-nC – DXSn SGD Count Pointer..... RO**

- 31-24 Current SGD Index
- 23-0 Current SGD Count

**SGD Table Format**

| <u>63</u> | <u>62</u> | <u>61</u> | <u>60-56</u> | <u>55-32</u> | <u>31-0</u> |
|-----------|-----------|-----------|--------------|--------------|-------------|
| EOL       | FLAG      | STOP      | -reserved-   | Base         | Base        |
|           |           | (FM       |              | Count        | Address     |
|           |           | Chan      |              | [23:0]       | [31:0]      |
|           |           | Only)     |              |              |             |

**EOL** End Of Link. 1 indicates this block is the last of the link. If the channel “Interrupt on EOL” bit is set, then an interrupt is generated at the end of the transfer.

**FLAG** Block Flag. If set, transfer pauses at the end of this block. If the channel “Interrupt on FLAG” bit is set, then an interrupt is generated at the end of this block.

**STOP** Block Stop. If set, transfer pauses at the end of this block. To resume the transfer, write 1 to Rx?0[2].

**I/O Offset 40 – 3D Channel SGD Status.....RWC**

- 7 SGD Active (0 = completed or terminated).....RO
- 6-3 Reserved ..... always reads 0
- 2 SGD Stopped .....RO
- 1 SGD EOL .....RWC
- 0 SGD Flag .....RWC

**I/O Offset 41 – 3D Channel SGD Control.....RW**

- 7 SGD Trigger ..... WO (always reads 0)
  - 0 No effect
  - 1 Trigger SGD Operation
- 6 SGD Terminate ..... WO (always reads 0)
  - 0 No effect
  - 1 Terminate SGD Operation
- 5 Auto Restart
  - 0 Stop SGD Operation at EOL
  - 1 Restart SGD Operation at EOL
- 4 SGD Pause
  - 0 Release SGD pause and resume the transfer from the paused line
  - 1 Pause SGD read operation (SGD pointer stays at the current address)
- 3-2 Reserved ..... always reads 0
- 1 Interrupt on EOL @ End of Block
  - 0 Disable .....default
  - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
  - 0 Disable .....default
  - 1 Enable

**I/O Offset 42 – 3D Channel SGD Format .....RW**

- 7 PCM Format
  - 0 8-bit .....default
  - 1 16-bit
- 6-4 # of Channels
  - 000 -invalid- .....default
  - 001 One channel
  - 010 Two channels
  - 011 Three channels
  - 100 Four channels
  - 101 Five channels
  - 110 Six channels
  - 111 -invalid-
- 3-0 Reserved ..... always reads 0

**I/O Offset 43 – Scratch .....RW**

- 7-0 No Assigned Hardware Function

**I/O Offset 47-44 – 3D Channel SGD Table Pointer ..... RW**

- 31-0 SGD Table Pointer Base Address (even addr) .... W
- Current Pointer Address ..... R

**I/O Offset 4B-48 – 3D Channel SGD Slot-Select..... RW**

- 31-24 Stop Index (SGD operation will stop at end of entry)
- 23-20 Slot 9 Data Select
  - 0000 No data assigned to slot 9
  - 0001 1<sup>st</sup> data in the sample is assigned to slot9
  - 0010 2<sup>nd</sup> data in the sample is assigned to slot9
  - 0011 3<sup>rd</sup> data in the sample is assigned to slot9
  - 0100 4<sup>th</sup> data in the sample is assigned to slot9
  - 0101 5<sup>th</sup> data in the sample is assigned to slot9
  - 0110 6<sup>th</sup> data in the sample is assigned to slot9
  - 0111 -invalid-
  - 1xxx -invalid-
- 19-16 Slot 6 Data Select
- 15-12 Slot 8 Data Select
- 11-8 Slot 7 Data Select
- 7-4 Slot 4 Data Select
- 3-0 Slot 3 Data Select

**I/O Offset 4F-4C – 3D Channel SGD Current Count..... RO**

- 31-24 Current SGD Index
- 23-0 Current SGD Count

**I/O Offset 50 – FM Channel SGD Status .....RWC**

- 7 SGD Active (0 = completed or terminated).....RO
- 6-3 Reserved ..... always reads 0
- 2 SGD Stopped .....RO
- 1 SGD EOL .....RWC
- 0 SGD Flag .....RWC

**I/O Offset 51 – FM Channel SGD Control.....RW**

- 7 SGD Trigger ..... WO (always reads 0)
  - 0 No effect
  - 1 Trigger SGD Operation
- 6 SGD Terminate ..... WO (always reads 0)
  - 0 No effect
  - 1 Terminate SGD Operation
- 5-4 Reserved (Do Not Program).....always write 0's
- 3 SGD Pause
  - 0 Release SGD pause and resume the transfer from the paused line
  - 1 Pause SGD read operation (SGD pointer stays at the current address)
- 2-0 Reserved (No Function)..... RW

**I/O Offset 52 – FM Channel SGD Type .....RW**

- 7 Auto Restart
  - 0 Stop SGD Operation at EOL
  - 1 Restart SGD Operation at EOL
- 6-4 Reserved ..... always reads 0
- 3-2 Interrupt Select
  - 00 Interrupt at last line PCI read
  - 01 Interrupt at last sample sent
  - 10 Interrupt at less than one line to send
  - 11 -reserved-
- 1 Interrupt on EOL @ End of Block
  - 0 Disable .....default
  - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
  - 0 Disable .....default
  - 1 Enable

**I/O Offset 57-54 – FM Channel SGD Table Pointer .....RW**

- 31-0 SGD Table Pointer Base Address (even addr)....W
- Current Pointer Address .....R

**I/O Offset 5F-5C – FM Channel SGD Current Count....RO**

- 31-24 Current SGD Index
- 23-0 Current SGD Count



**I/O Offset 60 – Wr Channel 0 SGD Status.....RWC**

- 7 SGD Active (0 = completed or terminated).....RO
- 6 SGD Paused .....RO
- 5-4 Reserved ..... always reads 0
- 3 SGD Trigger Queued (transaction will restart after EOL) .....RO
- 2 SGD Stopped .....RO
- 1 SGD EOL (clear interrupt if Rx62[1] is set) .....RWC
- 0 SGD Flag (clear interrupt if Rx62[0] is set) .....RWC

**I/O Offset 61 – Wr Channel 0 SGD Control .....RW**

- 7 SGD Trigger ..... WO (always reads 0)
  - 0 No effect
  - 1 Trigger SGD Operation
- 6 SGD Terminate ..... WO (always reads 0)
  - 0 No effect
  - 1 Terminate SGD Operation
- 5-4 Reserved ..... always reads 0
- 3 SGD Pause
  - 0 Release SGD pause and resume the transfer from the paused line
  - 1 Pause SGD read operation (SGD pointer stays at the current address)
- 3-2 Reserved ..... always reads 0

**I/O Offset 62 – Wr Channel 0 SGD Format.....RW**

- 7 Auto Restart
  - 0 Stop SGD Operation at EOL
  - 1 Restart SGD Operation at EOL
- 6 Recording FIFO
  - 0 Disable .....default
  - 1 Enable
- 5 PCM 8/16 Format (0=8bit, 1=16bit)
- 4 PCM Mono/Stereo Format (0=Mono, Stereo)
- 3-2 Recording Source
  - 00 Primary Codec
  - 01 Secondary Codec 01
  - 10 Secondary Codec 10
  - 11 -reserved-
- 1 Interrupt on EOL @ End of Block
  - 0 Disable .....default
  - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
  - 0 Disable .....default
  - 1 Enable

**I/O Offset 67-64 – Wr Channel 0 SGD Table Pointer....RW**

- 31-0 SGD Table Pointer Base Address (even addr)....W
- Current Pointer Address .....R

**I/O Offset 6F-6C – Wr Channel 0 SGD Current Count .RO**

- 31-24 Current SGD Index
- 23-0 Current SGD Count

**I/O Offset 70 – Wr Channel 1 SGD Status ..... RWC**

- 7 SGD Active (0 = completed or terminated) ..... RO
- 6 SGD Paused ..... RO
- 5-4 Reserved .....always reads 0
- 3 SGD Trigger Queued (transaction will restart after EOL) ..... RO
- 2 SGD Stopped..... RO
- 1 SGD EOL (clear interrupt if Rx62[1] is set)..... RWC
- 0 SGD Flag (clear interrupt if Rx62[0] is set) ..... RWC

**I/O Offset 71 – Wr Channel 1 SGD Control..... RW**

- 7 SGD Trigger..... WO (always reads 0)
  - 0 No effect
  - 1 Trigger SGD Operation
- 6 SGD Terminate.....WO (always reads 0)
  - 0 No effect
  - 1 Terminate SGD Operation
- 5-4 Reserved .....always reads 0
- 3 SGD Pause
  - 0 Release SGD pause and resume the transfer from the paused line
  - 1 Pause SGD read operation (SGD pointer stays at the current address)
- 3-2 Reserved .....always reads 0

**I/O Offset 72 – Wr Channel 1 SGD Format..... RW**

- 7 Auto Restart
  - 0 Stop SGD Operation at EOL
  - 1 Restart SGD Operation at EOL
- 6 Recording FIFO
  - 0 Disable..... default
  - 1 Enable
- 5 PCM 8/16 Format (0=8bit, 1=16bit)
- 4 PCM Mono/Stereo Format (0=Mono, Stereo)
- 3-2 Recording Source
  - 00 Primary Codec
  - 01 Secondary Codec 01
  - 10 Secondary Codec 10
  - 11 -reserved-
- 1 Interrupt on EOL @ End of Block
  - 0 Disable..... default
  - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
  - 0 Disable..... default
  - 1 Enable

**I/O Offset 77-74 – Wr Channel 1 SGD Table Pointer ... RW**

- 31-0 SGD Table Pointer Base Address (even addr) .... W
- Current Pointer Address ..... R

**I/O Offset 7F-7C – Wr Channel 1 SGD Current Count. RO**

- 31-24 Current SGD Index
- 23-0 Current SGD Count

**Offset E3-E0 – AC97 Controller Command / Status.....RW**

|              |                                                                                                                                                                                                                                                              |                |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>31-30</b> | <b>Codec ID</b> .....                                                                                                                                                                                                                                        | <b>RW</b>      |
|              | 00 Select Primary Codec                                                                                                                                                                                                                                      |                |
|              | 01 Select Secondary Codec 01                                                                                                                                                                                                                                 |                |
|              | 10 Select Secondary Codec 10                                                                                                                                                                                                                                 |                |
|              | 11 -reserved-                                                                                                                                                                                                                                                |                |
| <b>29</b>    | <b>Reserved</b> .....                                                                                                                                                                                                                                        | always reads 0 |
| <b>28</b>    | <b>AC97 Controller Busy</b> .....                                                                                                                                                                                                                            | <b>RO</b>      |
|              | 0 Primary Codec is ready for a register access command                                                                                                                                                                                                       |                |
|              | 1 AC97 Controller is sending a command to the primary codec (commands are not accepted)                                                                                                                                                                      |                |
| <b>27</b>    | <b>Reserved</b> .....                                                                                                                                                                                                                                        | always reads 0 |
| <b>26</b>    | <b>Secondary Codec 2 Data / Status Valid</b> .....                                                                                                                                                                                                           | <b>RWC</b>     |
|              | 0 Not Valid                                                                                                                                                                                                                                                  |                |
|              | 1 Valid (OK to Read bits 0-23)                                                                                                                                                                                                                               |                |
| <b>25</b>    | <b>Secondary Codec 1 Data / Status Valid</b> .....                                                                                                                                                                                                           | <b>RWC</b>     |
|              | 0 Not Valid                                                                                                                                                                                                                                                  |                |
|              | 1 Valid (OK to Read bits 0-23)                                                                                                                                                                                                                               |                |
| <b>24</b>    | <b>Primary Codec Data / Status Valid</b> .....                                                                                                                                                                                                               | <b>RWC</b>     |
|              | 0 Not Valid                                                                                                                                                                                                                                                  |                |
|              | 1 Valid (OK to Read bits 0-23)                                                                                                                                                                                                                               |                |
| <b>23</b>    | <b>Codec Command Register Read/Write Mode</b> ..                                                                                                                                                                                                             | <b>RW</b>      |
|              | 0 Select Codec command register write mode                                                                                                                                                                                                                   |                |
|              | 1 Select Codec command register read mode                                                                                                                                                                                                                    |                |
| <b>22-16</b> | <b>Codec Command Register Index [7:1]</b> .....                                                                                                                                                                                                              | <b>RW</b>      |
|              | Index of the AC97 codec command register to access (in the attached codec). Data must be written before or at the same time as Index as writing to the index triggers the AC97 controller to access the addressed codec register over the AC-link interface. |                |
| <b>15-0</b>  | <b>Codec Command Register Data / Status</b> .....                                                                                                                                                                                                            | <b>RW</b>      |
|              | W Codec Command Register Data                                                                                                                                                                                                                                |                |
|              | R Codec Status Register Data                                                                                                                                                                                                                                 |                |

**Offset F3-F0 – SGD Status Shadow ..... RO**

|           |                                            |                |
|-----------|--------------------------------------------|----------------|
| <b>31</b> | <b>Reserved</b> .....                      | always reads 0 |
| <b>30</b> | <b>Write Chan 1 SGD STOP Shadow</b> .....  | (Rx70[2])      |
| <b>29</b> | <b>Write Chan 1 SGD EOL Shadow</b> .....   | (Rx70[1])      |
| <b>28</b> | <b>Write Chan 1 SGD FLAG Shadow</b> .....  | (Rx70[0])      |
| <b>27</b> | <b>Reserved</b> .....                      | always reads 0 |
| <b>26</b> | <b>Write Chan 0 SGD STOP Shadow</b> .....  | (Rx60[2])      |
| <b>25</b> | <b>Write Chan 0 SGD EOL Shadow</b> .....   | (Rx60[1])      |
| <b>24</b> | <b>Write Chan 0 SGD FLAG Shadow</b> .....  | (Rx60[0])      |
| <b>23</b> | <b>Reserved</b> .....                      | always reads 0 |
| <b>22</b> | <b>FM Read Chan SGD STOP Shadow</b> .....  | (Rx50[2])      |
| <b>21</b> | <b>FM Read Chan SGD EOL Shadow</b> .....   | (Rx50[1])      |
| <b>20</b> | <b>FM Read Chan SGD FLAG Shadow</b> .....  | (Rx50[0])      |
| <b>19</b> | <b>Reserved</b> .....                      | always reads 0 |
| <b>18</b> | <b>3D Read Chan SGD STOP Shadow</b> .....  | (Rx40[2])      |
| <b>17</b> | <b>3D Read Chan SGD EOL Shadow</b> .....   | (Rx40[1])      |
| <b>16</b> | <b>3D Read Chan SGD FLAG Shadow</b> .....  | (Rx40[0])      |
| <b>15</b> | <b>Reserved</b> .....                      | always reads 0 |
| <b>14</b> | <b>DX3 Read Chan SGD STOP Shadow</b> ..... | (Rx30[2])      |
| <b>13</b> | <b>DX3 Read Chan SGD EOL Shadow</b> .....  | (Rx30[1])      |
| <b>12</b> | <b>DX3 Read Chan SGD FLAG Shadow</b> ..... | (Rx30[0])      |
| <b>11</b> | <b>Reserved</b> .....                      | always reads 0 |
| <b>10</b> | <b>DX2 Read Chan SGD STOP Shadow</b> ..... | (Rx20[2])      |
| <b>9</b>  | <b>DX2 Read Chan SGD EOL Shadow</b> .....  | (Rx20[1])      |
| <b>8</b>  | <b>DX2 Read Chan SGD FLAG Shadow</b> ..... | (Rx20[0])      |
| <b>7</b>  | <b>Reserved</b> .....                      | always reads 0 |
| <b>6</b>  | <b>DX1 Read Chan SGD STOP Shadow</b> ..... | (Rx10[2])      |
| <b>5</b>  | <b>DX1 Read Chan SGD EOL Shadow</b> .....  | (Rx10[1])      |
| <b>4</b>  | <b>DX1 Read Chan SGD FLAG Shadow</b> ..... | (Rx10[0])      |
| <b>3</b>  | <b>Reserved</b> .....                      | always reads 0 |
| <b>2</b>  | <b>DX0 Read Chan SGD STOP Shadow</b> ..... | (Rx00[2])      |
| <b>1</b>  | <b>DX0 Read Chan SGD EOL Shadow</b> .....  | (Rx00[1])      |
| <b>0</b>  | <b>DX0 Read Chan SGD FLAG Shadow</b> ..... | (Rx00[0])      |

**Function 5 I/O Base 1 Registers –Audio FM NMI Status**

**I/O Offset 0 – FM NMI Status .....RO**

7-2 **Reserved** ..... always reads 0

**1-0 FM NMI Status**

- 00 Undefined
- 01 OPL3 Bank 0
- 10 OPL3 Bank 1
- 11 Undefined

**I/O Offset 1 – FM NMI Data.....RO**

**7-0 FM NMI Data**

This register allows readback of the data written to the FM data port

**I/O Offset 2 – FM NMI Index .....RO**

**7-0 FM NMI Index**

This register allows readback of the data written to the FM index port

**Function 5 I/O Base 2 Registers –MIDI / Game Port**

**I/O Offset 1-0 – MIDI Port Base ..... RW**

**15-0 MIDI Port Base Address.....** default = 0330h

This register is functional only if Rx42[7] = 1

**I/O Offset 3-2 – Game Port Base ..... RW**

**15-0 Game Port Base Address .....** default = 0200h

**Function 6 I/O Base 0 Regs –Modem Scatter/Gather DMA**
**I/O Offset 0 – Modem Read Channel SGD Status.....RWC**

|     |                                                                 |
|-----|-----------------------------------------------------------------|
| 7   | SGD Active (0 = completed or terminated).....RO                 |
| 6   | SGD Paused .....RO                                              |
| 5-4 | Reserved ..... always reads 0                                   |
| 3   | SGD Trigger Queued (transaction will restart after EOL) .....RO |
| 2   | SGD Stopped .....RO                                             |
| 1   | SGD EOL .....RWC                                                |
| 0   | SGD Flag .....RWC                                               |

**I/O Offset 1 – Modem Read Channel SGD Control .....RW**

|     |                                                                     |
|-----|---------------------------------------------------------------------|
| 7   | SGD Trigger ..... WO (always reads 0)                               |
| 0   | No effect                                                           |
| 1   | Trigger SGD Operation                                               |
| 6   | SGD Terminate ..... WO (always reads 0)                             |
| 0   | No effect                                                           |
| 1   | Terminate SGD Operation                                             |
| 5-4 | Reserved (Do Not Program).....always write 0's                      |
| 3   | SGD Pause                                                           |
| 0   | Release SGD pause and resume the transfer from the paused line      |
| 1   | Pause SGD read operation (SGD pointer stays at the current address) |
| 2-0 | Reserved (No Function)..... RW                                      |

**I/O Offset 2 – Modem Read Channel SGD Type.....RW**

|     |                                         |
|-----|-----------------------------------------|
| 7   | Auto Restart                            |
| 0   | Stop SGD Operation at EOL               |
| 1   | Restart SGD Operation at EOL            |
| 6-4 | Reserved ..... always reads 0           |
| 3-2 | Interrupt Select                        |
| 00  | Interrupt at last line PCI read         |
| 01  | Interrupt at last sample sent           |
| 10  | Interrupt at less than one line to send |
| 11  | -reserved-                              |
| 1   | Interrupt on EOL @ End of Block         |
| 0   | Disable .....default                    |
| 1   | Enable                                  |
| 0   | Interrupt on FLAG @ End-of-Blk          |
| 0   | Disable .....default                    |
| 1   | Enable                                  |

**I/O Offset 7-4 – Modem SGD Read Table Pointer .....RW**

|      |                                                  |
|------|--------------------------------------------------|
| 31-0 | SGD Table Pointer Base Address (even addr).... W |
|      | Current Pointer Address .....R                   |

**I/O Offset F-C – Modem SGD Current Read Count.....RO**

|       |                               |
|-------|-------------------------------|
| 31-24 | Reserved ..... always reads 0 |
| 23-0  | Current SGD Read Count        |

**I/O Offset 10 – Modem Write Channel SGD Status... RWC**

|     |                                                                  |
|-----|------------------------------------------------------------------|
| 7   | SGD Active (0 = completed or terminated) ..... RO                |
| 6   | SGD Paused ..... RO                                              |
| 5-4 | Reserved .....always reads 0                                     |
| 3   | SGD Trigger Queued (transaction will restart after EOL) ..... RO |
| 2   | Reserved .....always reads 0                                     |
| 1   | SGD EOL (clear interrupt if Rx62[1] is set)..... RWC             |
| 0   | SGD Flag (clear interrupt if Rx62[0] is set) .... RWC            |

**I/O Offset 11 – Modem Write Channel SGD Control ... RW**

|     |                                                                     |
|-----|---------------------------------------------------------------------|
| 7   | SGD Trigger..... WO (always reads 0)                                |
| 0   | No effect                                                           |
| 1   | Trigger SGD Operation                                               |
| 6   | SGD Terminate..... WO (always reads 0)                              |
| 0   | No effect                                                           |
| 1   | Terminate SGD Operation                                             |
| 5-4 | Reserved .....always reads 0                                        |
| 3   | SGD Pause                                                           |
| 0   | Release SGD pause and resume the transfer from the paused line      |
| 1   | Pause SGD read operation (SGD pointer stays at the current address) |
| 3-2 | Reserved .....always reads 0                                        |

**I/O Offset 12 – Modem Write Channel SGD Format.... RW**

|     |                                 |
|-----|---------------------------------|
| 7   | Auto Restart                    |
| 0   | Stop SGD Operation at EOL       |
| 1   | Restart SGD Operation at EOL    |
| 6-2 | Reserved .....always reads 0    |
| 1   | Interrupt on EOL @ End of Block |
| 0   | Disable..... default            |
| 1   | Enable                          |
| 0   | Interrupt on FLAG @ End-of-Blk  |
| 0   | Disable..... default            |
| 1   | Enable                          |

**I/O Offset 17-14 – Modem Wr Chan SGD Table Ptr .... RW**

|      |                                                  |
|------|--------------------------------------------------|
| 31-0 | SGD Table Pointer Base Address (even addr).... W |
|      | Current Pointer Address ..... R                  |

**I/O Offset 1F-1C – Modem Wr Chan SGD Current CntRO**

|       |                   |
|-------|-------------------|
| 31-24 | Current SGD Index |
| 23-0  | Current SGD Count |

**Offset 23-20 – Modem Codec Command / Status .....RW**

- 31-30 Codec ID** ..... RW  
     00 Select Primary Codec  
     01 Select Secondary Codec 01  
     10 Select Secondary Codec 10  
     11 -reserved-
- 29-24 Reserved** ..... always reads 0
- 28 AC97 Controller Busy** ..... RO  
     0 Primary Codec is ready for a register access command  
     1 AC97 Controller is sending a command to the primary codec (commands are not accepted)
- 27 Reserved** ..... always reads 0
- 26 Secondary Codec 2 Data / Status Valid**.....RWC  
     0 Not Valid  
     1 Valid (OK to Read bits 0-23)
- 25 Secondary Codec 1 Data / Status Valid**.....RWC  
     0 Not Valid  
     1 Valid (OK to Read bits 0-23)
- 24 Primary Codec Data / Status Valid** .....RWC  
     0 Not Valid  
     1 Valid (OK to Read bits 0-23)
- 23 Codec Command Register Read/Write Mode ..** RW  
     0 Select Codec command register write mode  
     1 Select Codec command register read mode
- 22-16 Codec Command Register Index [7:1]** ..... RW  
     Index of the AC97 codec command register to access (in the attached codec). Data must be written before or at the same time as Index as writing to the index triggers the AC97 controller to access the addressed codec register over the AC-link interface.
- 15-0 Codec Command Register Data / Status** ..... RW  
     W Codec Command Register Data  
     R Codec Status Register Data

**Offset 33-30 – Codec GPI Interrupt Status / GPIO .... RWC**

- 31-16 GPI Interrupt Status** ..... RWC  
     R GPI[15-0] Interrupt Status  
     W 1 to clear
- 15-0 Codec GPIO** .....RW  
     R Reflect status of Codec GPI[15-0]  
     W GPO[15-0]; triggers AC-Link slot-12 output to codec

**Offset 37-34 – Codec GPI Interrupt Enable..... RW**

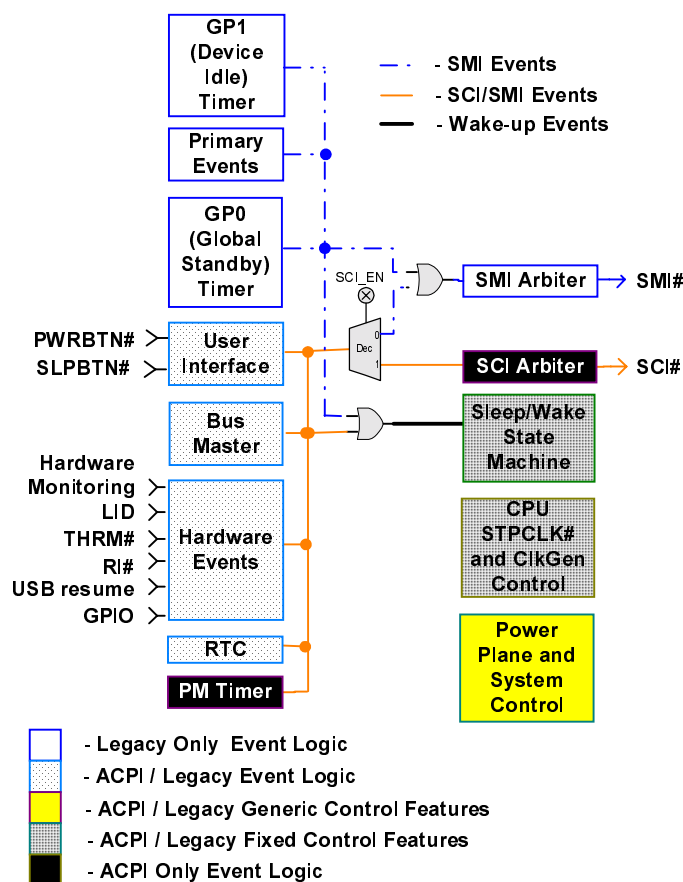
- 31-16 Interrupt on GPI[15-0] Change of Status**.....RW  
     0 Disable  
     1 Enable
- 15-0 Reserved** .....always reads 0

# FUNCTIONAL DESCRIPTIONS

## Power Management

### Power Management Subsystem Overview

The power management function of the VT8231 is indicated in the following block diagram:



**Figure 6. Power Management Subsystem Block Diagram**

Refer to ACPI Specification v1.0 and APM specification v1.2 for additional information.

### Processor Bus States

The VT8231 supports the complete set of C0 to C3 processor states as specified in the Advanced Configuration and Power Interface (ACPI) specification (and defined in ACPI I/O space Registers 10-15):

- C0: Normal Operation
- C1: CPU Halt (controlled by software).
- C2: Stop Clock. Entered when the P\_LVL2 register is read. The STPCLK# signal is asserted to put the processor in the Stop Grant State. The CPUSTP# signal is not asserted so that host clocks remain running. To exit this state, the chip negates STPCLK#.
- C3: Suspend. Entered when the P\_LVL3 register is read. In addition to STPCLK# assertion as in the C2 state, the SUSST1# (suspend status 1) signal is asserted to tell the north bridge to switch to "Suspend DRAM Refresh" mode based on the 32KHz suspend clock (SUSCLK) provided by the VT8231. If the HOST\_STP bit is enabled, then CPUSTP# is also asserted to stop clock generation and put the CPU into Stop Clock State. To exit this state, the chip negates CPUSTP# and allows time for the processor PLL to lock. Then the SUSST1# and STPCLK# signals are negated to resume to normal operation.

During normal operation, two mechanisms are provided to modulate CPU execution and control power consumption by throttling the duty cycle of STPCLK#:

- a. Setting the THT\_EN bit to 1, the duty cycle defined in THT\_DTY (IO space Rx10) is used.
- b. THRM# pin assertion enables automatic clock throttling with duty cycle pre-configured in THM\_DTY (PCI configuration Rx4C).

## **System Suspend States and Power Plane Control**

There are three power planes inside the VT8231. The first power plane (VCCS) is always on unless turned off by the mechanical switch. The second power plane (VCC) is controlled by chip output SUSC# (also called "PSON"). The third plane (VCCRTC) is powered by the combination of the VCCS and the external battery (VBAT) for the integrated real time clock. Most of the circuitry inside the VT8231 is powered by VCC. The amount of logic powered by VCCS is very small; its main function is to control the supply of VCC and other power planes. VCCRTC is always on unless both the mechanical switch and VBAT are removed.

The VT8231 supports multiple system suspend states by configuring the SLP\_TYP field of ACPI I/O space register Rx4-5:

- a) **POS (Power On Suspend):** Most devices in the system remain powered. The host bus is put into an equivalent of the C3 state. In particular, the CPU is put into the Stop Grant State or Stop Clock State depending on the setting of the HOST\_STP bit. SUSST1# is asserted to tell the north bridge to switch to "Suspend DRAM Refresh" mode based on the 32KHz SUSCLK provided by the VT8231. As to the PCI bus, setting the PCLK\_RUN bit to 0 enables the CLKRUN protocol defined in the PCI Mobile Design Guide. That is, the PCKRUN# pin will be deactivated after the PCI bus is idle for 26 clocks. Any PCI bus masters including the north bridge may resume PCI clock operation by pulling the PCKRUN# pin low. During the PCKRUN# deactivation period, the PCISTP# pin may be activated to disable the output of the PCI clock generator if the PCI\_STP bit is enabled. When the system resumes from POS, the VT8231 can optionally resume without resetting the system, can reset the processor only, or can reset the entire system. When no reset is performed, the chip only needs to wait for the clock synthesizer and processor PLL to lock before the system is resumed, which typically takes 20ms.
- b) **STR (Suspend to RAM):** Power is removed from most of the system except the system DRAM. Power is supplied to the suspend refresh logic in the north bridge (VTT of VT82C598) and the suspend logic of the VT8231 (VCCS). The VT8231 provides a 32KHz suspend clock to the north bridge for it to use to continue DRAM refresh.
- c) **STD (Suspend to Disk, also called Soft-off):** Power is removed from most of the system except the suspend logic of VT8231 (VCCS).
- d) **Mechanical Off:** This is not a suspend state. All power in the system is removed except the RTC battery.

The suspend state is entered by setting the SLP\_EN bit to 1. Three power plane control signals (SUSA#, SUSB# and

SUSC#) are provided to turn off more system power planes as the system moves to deeper power-down states, i.e., from normal operation to POS (only SUSA# asserted), to STR (both SUSA# and SUSB# asserted), and to STD (all three SUS# signals asserted). In particular, the assertion of SUSC# can be used to turn off the VCC supply to the VT8231.

One additional suspend status indicator (SUSST1#) is provided to inform the north bridge and the rest of the system of the processor and system suspend states. SUSST1# is asserted when the system enters the suspend state or the processor enters the C3 state. SUSST1# is connected to the north bridge to switch between normal and suspend-DRAM-refresh modes.

## **General Purpose I/O Ports**

As ACPI compliant hardware, the VT8231 includes PWRBTN#, SLPBTN#, and RI# pins to implement power button, sleep button, and ring indicator functionality, respectively. Furthermore, the VT8231 offers many general-purpose I/O ports with the following capabilities:

- **I<sup>2</sup>C/SMB Support**
- **Thermal Detect**
- **Notebook Lid Open/Close Detect**
- **Battery Low Detect**
- **Twelve General Purpose Input Ports** (multiplexed with other functions).
- **Nineteen General Purpose Output Ports** (1 dedicated and 18 multiplexed with other functions)
- **Four General Purpose Input / Output Ports** (multiplexed with other functions)

In addition, the VT8231 provides an external dedicated SMI pin (EXTSMI#). The external SMI input can be programmed to trigger an SCI or SMI at both the rising and falling edges of the corresponding input signal. Software can check the status of the input pin and take appropriate actions.



## Power Management Events

Three types of power management events are supported:

- 1) **ACPI-required Fixed Events** defined in the PM1a\_STS and PM1a\_EN registers. These events can trigger either SCI or SMI depending on the SCI\_EN bit:

- PWRBTN# Triggering
- RTC Alarm
- Sleep Button
- ACPI Power Management Timer Carry (always SCI)
- BIOS Release (always SCI)

- 2) **ACPI-aware General Purpose Function Events** defined in the GP\_STS and GP\_SCI\_EN, and GP\_SMI\_EN registers. These events can trigger either SCI or SMI depending on the setting of individual SMI and SCI enable bits:

- External SMI triggering
- USB Resume
- Ring Indicator (RI#)
- Battery Low Detect (BATLOW#)
- Notebook Lid Open/Close Detect (LID)
- Thermal Detect (THRM#)

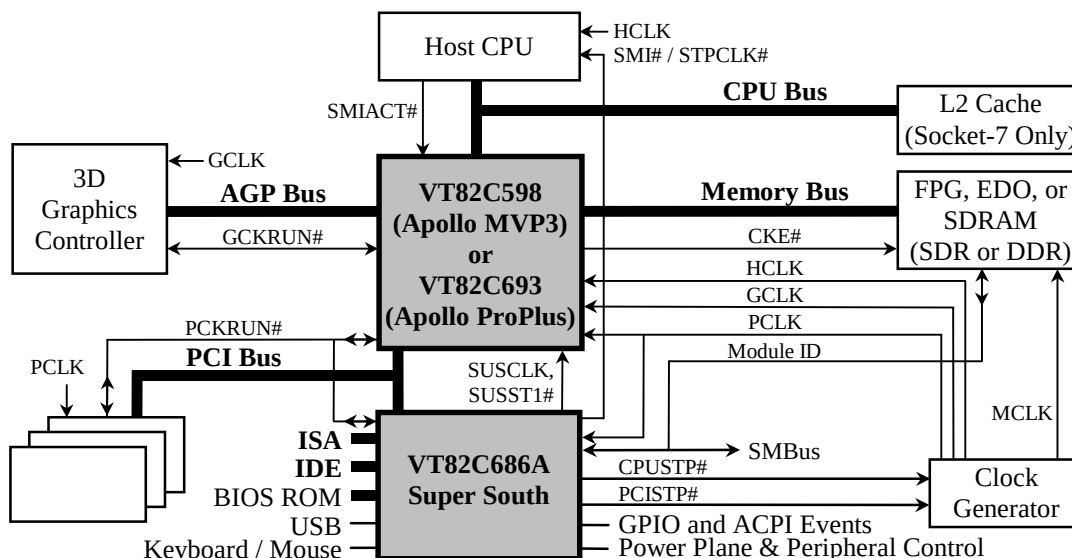
- 3) **Generic Global Events** defined in the GBL\_STS and GBL\_EN registers. These registers are mainly used for SMI:

- PCI Bus Clock Run Resume
- Primary Interrupt Occurance
- GP0 and GP1 Timer Time Out
- Secondary Event Timer Time Out
- Occurrence of Primary Events (defined in register PACT\_STS and PACT\_EN)
- Legacy USB accesses (keyboard and mouse)
- Software SMI

## System and Processor Resume Events

Depending on the system suspend state, different features can be enabled to resume the system. There are two classes of resume events:

- a) **VCCS-based events.** Event logic resides in the VCCS plane and thus can resume the system from any suspend state. Such events include PWRBTN#, RI#, BATLOW#, LID, SMBus resume event, RTC alarm, EXTSMI#, and GP1 (EXTSMI1#).
- b) **VCC-Based Events.** Event logic resides in the VCC plane and thus can only resume the system from the POS state. Such events include the ACPI PM timer, USB resume, and EXTSMIn#.



**Figure 7. System Block Diagram Using the VT8231 Super South Bridge**



### **Legacy Power Management Timers**

In addition to the ACPI power management timer, the VT8231 includes the following four legacy power management timers:

- GP0 Timer:** general purpose timer with primary event
- GP1 Timer:** general purpose timer with peripheral event reload
- Secondary Event Timer:** to monitor secondary events
- Conserve Mode Timer:** Hardware-controlled return to standby

The normal sequence of operations for a general purpose timer (GP0 or GP1) is to

- 1) First program the time base and timer value of the initial count (register GP\_TIM\_CNT).
- 2) Then activate counting by setting the GP0\_START or GP1\_START bit to one: the timer will start with the initial count and count down towards 0.
- 3) When the timer counts down to zero, an SMI will be generated if enabled (GP0TO\_EN and GP1TO\_EN in the GBL\_EN register) with status recorded (GP0TO\_STS and GP1TO\_STS in the GBL\_STS register).
- 4) Each timer can also be programmed to reload the initial count and restart counting automatically after counting down to 0. This feature is not used in standard VIA BIOS.

The GP0 and GP1 timers can be used just as the general purpose timers described above. However, they can also be programmed to reload the initial count by system primary events or peripheral events thus used as primary event (global standby) timer and peripheral timer, respectively. The secondary event timer is solely used to monitor secondary events.

### **System Primary and Secondary Events**

Primary system events are distinguished in the PRI\_ACT\_STS and PRI\_ACT\_EN registers:

| <u>Bit</u> | <u>Event</u>                   | <u>Trigger</u>                                                                                    |
|------------|--------------------------------|---------------------------------------------------------------------------------------------------|
| 7          | <b>Keyboard Access</b>         | I/O port 60h                                                                                      |
| 6          | <b>Serial Port Access</b>      | I/O ports 3F8h-3FFh, 2F8h-2FFh, 3E8h-3EFh, or 2E8h-2EFh                                           |
| 5          | <b>Parallel Port Access</b>    | I/O ports 378h-37Fh or 278h-27Fh                                                                  |
| 4          | <b>Video Access</b>            | I/O ports 3B0h-3DFh or memory A/B segments                                                        |
| 3          | <b>IDE/Floppy Access</b>       | I/O ports 1F0h-1F7h, 170h-177h, or 3F5h                                                           |
| 2          | <b>Reserved</b>                |                                                                                                   |
| 1          | <b>Primary Interrupts</b>      | Each channel of the interrupt controller can be programmed to be a primary or secondary interrupt |
| 0          | <b>ISA Master/DMA Activity</b> |                                                                                                   |

Each category can be enabled as a primary event by setting the corresponding bit of the PRI\_ACT\_EN register to 1. If enabled, the occurrence of the primary event reloads the GP0

timer if the PACT\_GP0\_EN bit is also set to 1. The cause of the timer reload is recorded in the corresponding bit of PRI\_ACT\_STS register while the timer is reloaded. If no enabled primary event occurs during the count down, the GP0 timer will time out (count down to 0) and the system can be programmed (setting the GP0TO\_EN bit in the GBL\_EN register to one) to trigger an SMI to switch the system to a power down mode.

The VT8231 distinguishes two kinds of interrupt requests as far as power management is concerned: the primary and secondary interrupts. Like other primary events, the occurrence of a primary interrupt demands that the system be restored to full processing capability. Secondary interrupts, however, are typically used for housekeeping tasks in the background unnoticeable to the user. The VT8231 allows each channel of interrupt request to be declared as either primary, secondary, or ignorable in the PIRQ\_CH and SIRQ\_CH registers. Secondary interrupts are the only system secondary events defined in the VT8231.

Like primary events, primary interrupts can be made to reload the GP0 timer by setting the PIRQ\_EN bit to 1. Secondary interrupts do not reload the GP0 timer. Therefore the GP0 timer will time out and the SMI routine can put the system into power down mode if no events other than secondary interrupts are happening periodically in the background.

Primary events can be programmed to trigger an SMI (setting of the PACT\_EN bit). Typically, this SMI triggering is turned off during normal system operation to avoid degrading system performance. Triggering is turned on by the SMI routine before entering the power down mode so that the system may be returned to normal operation at the occurrence of primary events. At the same time, the GP0 timer is reloaded and the count down process is restarted.

### **Peripheral Events**

Primary and secondary events define system events in general and the response is typically expressed in terms of system events. Individual peripheral events can also be monitored by the VT8231 through the GP1 timer. The following four categories of peripheral events are distinguished (via register GP\_RLD\_EN):

- Bit-7 **Keyboard Access**
- Bit-6 **Serial Port Access**
- Bit-4 **Video Access**
- Bit-3 **IDE/Floppy Access**

The four categories are subsets of the primary events as defined in PRI\_ACT\_EN and the occurrence of these events can be checked through a common register PRI\_ACT\_STS. As a peripheral timer, GP1 can be used to monitor one (or more than one) of the above four device types by programming the corresponding bit to one and the other bits to zero. Time out of the GP1 timer indicates no activity of the corresponding device type and appropriate action can be taken as a result.

## ELECTRICAL SPECIFICATIONS

### Absolute Maximum Ratings

| Parameter                          | Min  | Max                    | Unit  | Comment                                                               |
|------------------------------------|------|------------------------|-------|-----------------------------------------------------------------------|
| Storage temperature                | -55  | 125                    | °C    | T <sub>S</sub>                                                        |
| Operating temperature - Case       | 0    | 85                     | °C    | T <sub>C</sub>                                                        |
| Operating temperature - Ambient    | 0    | 70                     | °C    | T <sub>A</sub>                                                        |
| Reference Voltage                  | 0    | 5.5                    | Volts | V <sub>REF</sub>                                                      |
| Core Voltage                       | 0    | 3.6                    | Volts | V <sub>CC</sub>                                                       |
| Suspend Voltage                    | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>SUS</sub>                                                      |
| USB Voltage                        | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>USB</sub>                                                      |
| Hardware Monitor Voltage           | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>HWM</sub>                                                      |
| LAN MII Voltage                    | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>MII</sub>                                                      |
| LAN RAM Voltage                    | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>RAM</sub>                                                      |
| PLL Voltage                        | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>PLL</sub>                                                      |
| Battery Voltage                    | -0.5 | V <sub>CC</sub> + 0.3  | Volts | V <sub>BAT</sub>                                                      |
| Input voltage (3.3V only inputs)   | -0.5 | V <sub>CC</sub> + 0.3  | Volts | FERR#, USBCLK, PWRBTN#, EXTSMI#, BATLOW#, FAN1, FAN2, SMBCLK, SMBDATA |
| Input voltage (5V tolerant inputs) | -0.5 | V <sub>REF</sub> + 0.5 | Volts | All other inputs                                                      |

Note: Stress above the conditions listed may cause permanent damage to the device. Functional operation of this device should be restricted to the conditions described under operating conditions.

### DC Characteristics

T<sub>A</sub> -0-70°C, V<sub>REF</sub>=5V ±5%, V<sub>BAT</sub>=3.3V +0.3/-1.3V, GND=0V  
V<sub>CC</sub>=V<sub>CCSUS</sub>=V<sub>CCHWM</sub>=V<sub>CCUSB</sub>=V<sub>CCMII</sub>=V<sub>CCRAM</sub>=V<sub>CCPLL</sub>=3.3V ±0.3V

| Symbol          | Parameter                | Min  | Max                  | Unit | Condition                                 |
|-----------------|--------------------------|------|----------------------|------|-------------------------------------------|
| V <sub>IL</sub> | Input low voltage        | -0.5 | 0.8                  | V    |                                           |
| V <sub>IH</sub> | Input high voltage       | 2.0  | V <sub>CC</sub> +0.3 | V    |                                           |
| V <sub>OL</sub> | Output low voltage       | -    | 0.45                 | V    | I <sub>OL</sub> = 4.0mA                   |
| V <sub>OH</sub> | Output high voltage      | 2.4  | -                    | V    | I <sub>OH</sub> = -1.0mA                  |
| I <sub>IL</sub> | Input leakage current    | -    | ±10                  | uA   | 0 < V <sub>IN</sub> < V <sub>CC</sub>     |
| I <sub>OZ</sub> | Tristate leakage current | -    | ±20                  | uA   | 0.45 < V <sub>OUT</sub> < V <sub>CC</sub> |
| I <sub>CC</sub> | Power supply current     | -    | 80                   | mA   |                                           |

## Output Drive

$T_A$  -0-70°C,  $V_{REF}=5V \pm 5\%$ ,  $V_{BAT}=3.3V +0.3/-1.3V$ ,  $GND=0V$   
 $V_{CC}=V_{CCSUS}=V_{CCHWM}=V_{CCUSB}=V_{CCMII}=V_{CCRAM}=V_{CCPLL}=3.3V \pm 0.3V$

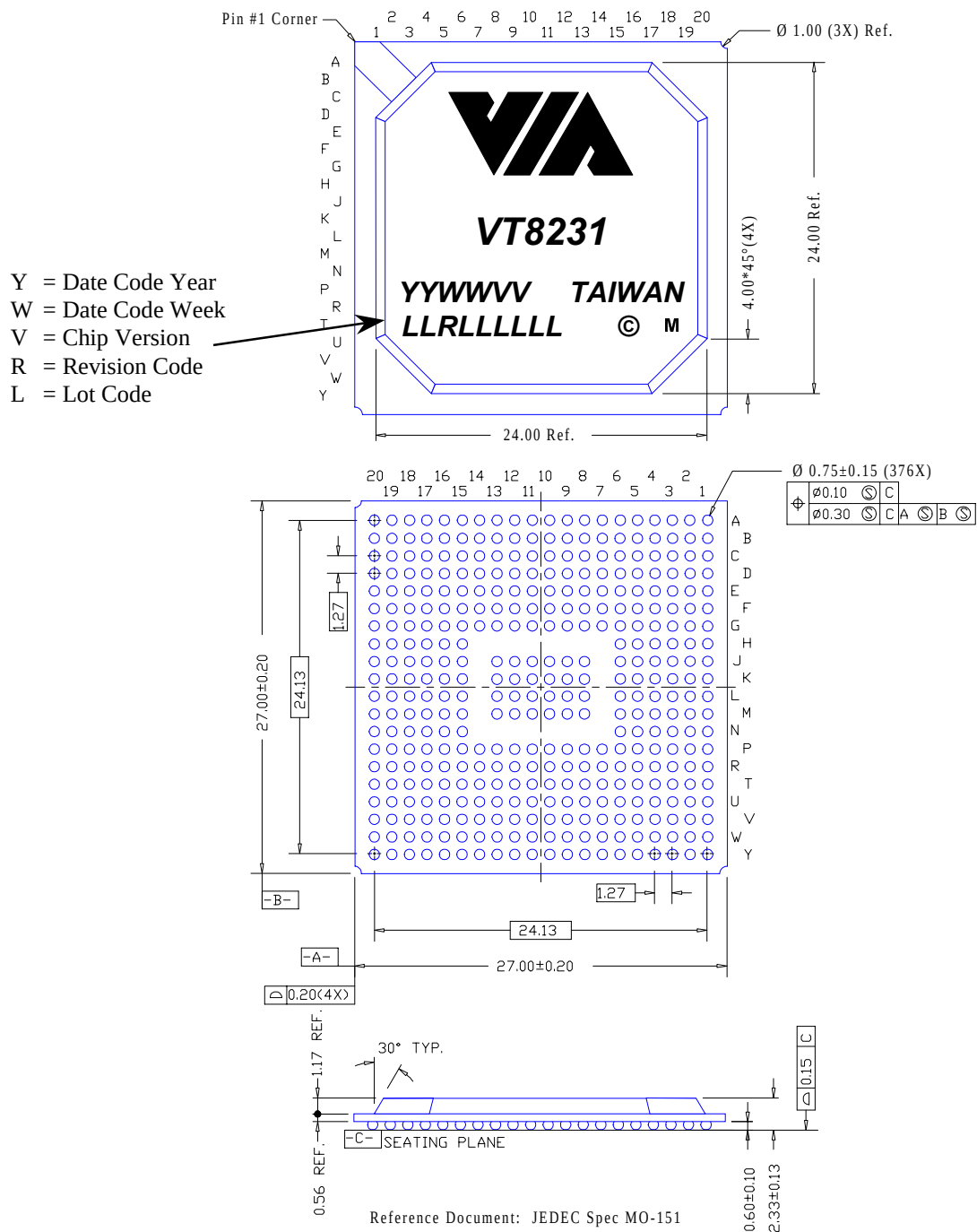
| Drive | Signal                                                                                                                                                                                                                                        | Load  | Delay |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| 4 mA  | GPO0, GPIOA, GPIOC, GPIOD, GPIOE, EECS#, EECK, EEDO, APICD[1:0],<br>SMBCK1, SMBCK2, SMBDT1, SMBDT2,<br>SUSA#, SUSB#, SUSC#, SUSCLK, SUSST1#,<br>A20M#, INIT, INTR, NMI, ROMCS#, STPCLK#, CPURST, SMI#, IGNNE#, SLP#,<br>TXD, RTS#, DTR#, IRTX | 50 pF | 15 ns |
|       |                                                                                                                                                                                                                                               | 50 pF | 15 ns |
|       |                                                                                                                                                                                                                                               | 50 pF | 15 ns |
|       |                                                                                                                                                                                                                                               | 50 pF | 15 ns |
|       |                                                                                                                                                                                                                                               | 50 pF | 15 ns |
| 8 mA  | KBDT, KBCK, MSDT, MSCK,<br>PCISTP#, CPUTSP#,<br>SD[15:0], PDD[15:0], SDD[15:0],<br>MDCK, MDIO, MTXENA, MTXD[3:0],<br>PREQL#, PREQH#                                                                                                           | 50 pF | 10 ns |
|       |                                                                                                                                                                                                                                               | 50 pF | 8 ns  |
|       |                                                                                                                                                                                                                                               | 50 pF | 8 ns  |
|       |                                                                                                                                                                                                                                               | 50 pF | 8 ns  |
|       |                                                                                                                                                                                                                                               | 30 pF | 6 nS  |
| 12 mA | PDCS1#, PDCS3#, SDCS1#, SDCS3#, PDA[2:0], SDA[2:0],<br>PDDACK#, SDDACK#, PDIOR#, PDIO#W, SDIOR#, SDIO#W                                                                                                                                       | 40 pF | 8 ns  |
|       |                                                                                                                                                                                                                                               | 40 pF | 8 ns  |
| 16 mA | LA[21:20], SA[19:0], MEMR#, MEMW#, IOR#, IOW#, PCIRST#                                                                                                                                                                                        | 85 pF | 10 ns |
| PCI   | AD[31:0],<br>CBE[3:0]#, FRAME#, DEVSEL#, IRDY#, TRDY#, STOP#, PAR, PCKRUN#                                                                                                                                                                    | 50 pF | 6 ns  |
|       |                                                                                                                                                                                                                                               | 50 pF | 5 ns  |
|       | LFRAME#, LAD[3:0], USBP[3:0]+/-                                                                                                                                                                                                               |       |       |
|       | ACRST, ACSYNC, ACSDOUT, MSO                                                                                                                                                                                                                   |       |       |
|       | PCS0#, PCS1#, MCCS#, SPKR                                                                                                                                                                                                                     |       |       |
|       | DRV DEN[1:0], MTR[1:0]#, DS[1:0]#, DIR#, STEP#, HDSEL#, WDATA#, WGATE#                                                                                                                                                                        |       |       |
|       | PINIT#, STROBE#, AUTOFD#, SLCTIN#, PD[7:0]                                                                                                                                                                                                    |       |       |
|       | RTCX2                                                                                                                                                                                                                                         |       |       |

## Input Voltage

$T_A$  -0-70°C,  $V_{REF}=5V \pm 5\%$ ,  $V_{BAT}=3.3V +0.3/-1.3V$ ,  $GND=0V$   
 $V_{CC}=V_{CCSUS}=V_{CCHWM}=V_{CCUSB}=V_{CCMII}=V_{CCRAM}=V_{CCPLL}=3.3V \pm 0.3V$

| Input Voltage                     | Signal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analog                            | DTD+/-, UIC[5:1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 1.5 – 3.3V Programmable Threshold | FERR#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 5V                                | AD[31:0], CBE[3:0]#, FRAME#, DEVSEL#, IRDY#, TRDY#, STOP#, SERR#,<br>PAR, SERIRQ, PCKRUN#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 3.3V (5V Tolerant)                | PGNTH#, PGNTL#, PINT[A:D]#,<br>SA[19:0], SD[15:0], MEMR#, MEMW#, IOR#, IOW#, OSC,<br>PDD[15:0], SDD[15:0], PDDRQ, SDDRQ, PDRDY, SDRDY, IRQ14, IRQ15,<br>KBCK, KBDT, MSCK, MSDT, GAMED[7:0],<br>INDEX#, TRK00#, RDATA#, DSKCHG#, WRTPR#T, PD[7:0],<br>PINIT#, STROBE#, AUTOFD#, SLCTIN#, SLCT, ACK#, ERROR#, BUSY, PE,<br>RXD, CTS#, DSR#, DCD#, RI#, IRRX, IRRX2,<br>SMBCK1, SMBCK2, SMBDT1, SMBDT2, SMBALRT#,<br>MCOL, MCRS, MDIO, MRXCLK, MRXD[3:0], MRXDV, MRXERR, MTXCLK,<br>MSI, ACSDIN[2:0], ACBITCLK,<br>GPIOA, GPIOC, GPIOD, GPIOE, GPIO, GPI1, PWRGD, BATLOW#, THRM |
| 3.3 V                             | USBP[3:0]+/-, USBCLK, USBOC[1:0]#, LDRQ#, LAD[3:0], EEDI,<br>PCICLK, APICCLK, WSC#, FAN1, FAN2 / SLPBTN#, PWRBTN#, RTCX1,<br>EXTSMI#, RSMRST#, PME#, LID, RING#, CPUMISS, INTRUDER#                                                                                                                                                                                                                                                                                                                                                                                          |

## PACKAGE MECHANICAL SPECIFICATIONS



**Figure 8. Mechanical Specifications – 376 Pin Ball Grid Array Package**