



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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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
INTEGRATED SUPER-I/O (FDC, LPT, COM, AND FIR),
INTEGRATED FAST ETHERNET, LPC, ISA / LPC BIOS ROM,
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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.

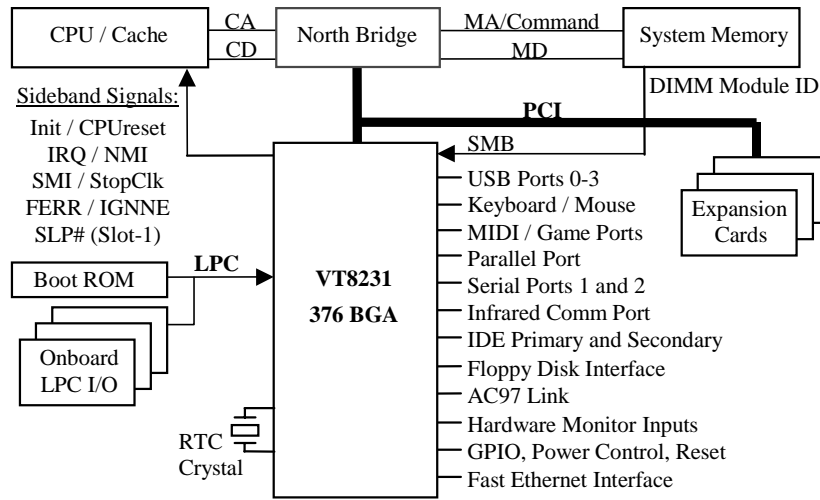


Figure 1. PC System Configuration Using the VT8231

PINOOTS

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	GPIO C	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#	GPIO A	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#	GPIO E	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	GPIO D	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

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	D15	P GNDUSB	H06	P VCC	P05	P VCCSUS	U16	IO SA06 / SDD06
A05	IO AD21	D16	I USBOC1#	H15	P GND	P06	P VCCSUS	U17	I SDDRO
A06	IO AD16	D17	O MDCK	H16	I TRK00#	P07	P GND	U18	O SDCS1#
A07	IO DEVSEL#	D18	IO MDIO	H17	I WRTPRT#	P08	P VCC	U19	O SDCS3#
A08	IO CBE1#	D19	I MRXD3	H18	I DSKCHG#	P09	P VCC	U20	IO PDD02
A09	IO AD09	D20	I MRXD2	H19	OD HDSEL#	P10	P GND	V01	IO PCKRUN#
A10	IO AD05	E01	O RTCX2	H20	I RDATA#	P11	P VCC	V02	IO GPIOA / GPIO24
A11	IO STROBE#	E02	I RTCX1	J01	O PCS1# / SDI2 / IO	P12	P VCC	V03	I GPI1 / IRO8#
A12	IO PD2 / WRTPRT#	E03	I PWRGD	J02	IO GPIOC/IO25/ATST	P13	P VCC	V04	I WSC#/ARO#/124
A13	IO PD6	E04	O PCIRST#	J03	I ACBITCLK	P14	P GND	V05	OD INIT
A14	I BUSY / MTR1#	E05	IO AD22	J04	O MSO / SPDIF	P15	P VCC	V06	OD STPCLK#
A15	O RTS#	E06	IO AD17	J05	I JBY / GAMED3	P16	IO PDD04	V07	IO LAD3
A16	O DTR#	E07	I SBRR#	J06	P VCC	P17	IO PDD11	V08	IO LAD0
A17	I USBOC0#	E08	IO AD13	J15	P VCC	P18	IO PDD08	V09	I SERIRO#
A18	IO USBP2-	E09	IO AD08	J16	OD MTR1#	P19	I PDDRO	V10	O LGT2#/SD15/O11
A19	IO USBP1-	E10	IO AD03	J17	OD DS0#	P20	O PDIOW#	V11	I HRQ2#/SD10/I11
A20	IO USBP0-	E11	IO AUTOFD#/DRV0	J18	OD STEP#	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	K01	P VREF	R04	O SLOWCLK / O0	V15	IO SA11 / SDD11
B04	IO AD25	E15	P VCCUSB	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	R07	P VCC	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	K06	P GND	R09	P VCC	V20	O SDA2
B09	IO AD10	E20	I MRXDV / AIRO	K15	P VCC	R10	P VCC	W01	O PCISTP# / GPO6
B10	IO AD04	F01	I JBB1 / GAMED6	K16	P VCCMII	R11	IO SD06	W02	O CPUSTP# / GPO5
B11	IO AD01	F02	P VBAT	K17	OD DRV DEN1	R12	IO SD00	W03	IO GPIOE / GPIO31
B12	IO PINT# / DIR#	F03	I INTRUDER#/GPI8	K18	OD MTR0#	R13	P VCC	W04	O APD0/ACS#/IO28
B13	IO PD5	F04	I GPIO	K19	OD DS1#	R14	P VCC	W05	OD A20M#
B14	I ACK# / DS1#	F05	I RSMRST#	K20	OD DIR#	R15	P VCC	W06	O MCCS#/O17/strap
B15	O TXD	F06	IO FRAME#	L01	AI UIC5	R16	IO PDD01	W07	IO LAD2
B16	I CTS#	F07	P VCC	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+	F09	P VCC	L04	AI UIC4	R19	IO PDD09	W10	I LRQ2#/SD14/I13
B19	IO USBP1+	F10	IO CBE0#	L05	P GNDHWM	R20	IO PDD06	W11	O HG11#/SD09/O8
B20	IO USBP0+	F11	I ERROR#/HDSEL#	L06	P VCC	T01	IO SMBDT1	W12	IO SD02
C01	O PREOH#	F12	P VCC	L15	P GND	T02	I SMBALRT# / GPI7	W13	IO LA20/OC2#/O20
C02	I PINTD#	F13	P VCC	L16	P VCCPLL	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	F15	P VCC	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	F16	P VCCMII	L20	I INDEXT#	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	M05	P VCCHWM	T12	I OSC	Y03	I APICCLK / GPI9
C12	IO PD1 / TRK00#	G03	I JAB1 / GAMED4	M06	P VCC	T13	IO SA17 / strap	Y04	O APD1/AK#/IO29
C13	IO PD4 / DSKCHG#	G04	I MSI / I2S	M15	P VCC	T14	I IRO14	Y05	OD SMI#
C14	IO PD7	G05	I JAX / GAMED0	M16	P GNDPLL	T15	IO SA08 / SDD08	Y06	O PCS0#/O16/strap
C15	I USBCLK	G06	P VCC	M17	I PCICLK	T16	IO PDD00	Y07	IO LAD1
C16	I RI#	G07	P GND	M18	O PDA1	T17	IO PDD15	Y08	I LDRQ#/SIN3/I15
C17	IO USBP3+	G08	P VCC	M19	O PDA0	T18	IO PDD13	Y09	IO MEMW#
C18	O EECS#	G09	P VCC	M20	O PDA2	T19	IO PDD03	Y10	O LG1# / SD13/O10
C19	I EEDI	G10	P VCC	N01	IO KBDT / KBRC	T20	IO PDD12	Y11	I HRO1#/SD08/I10
C20	O EEDO	G11	P GND	N02	IO MSCK / IRO1	U01	I PME# / GPI6	Y12	IO SD03
D01	I PGNTL#	G12	P VCC	N03	O SUSCK / GPO	U02	I PWRBTN#	Y13	IO LA21/OC3#/O21
D02	O PREQL#	G13	P GNDDRAM	N04	IO MSDT / IRO12	U03	I RING# / GPI3	Y14	IO SA16 / strap
D03	I PGNTH#	G14	P GND	N05	O SUSST1# / GPO3	U04	OD CPURST	Y15	IO SA10 / SDD10
D04	IO AD29	G15	P VCCRAM	N06	P VCC	U05	I FERR#	Y16	IO SA03 / SDD03
D05	IO AD20	G16	I MCRS / AIRO	N15	P GND	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 / INDEXT#	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#/HDSEL#	D18	IO MDIO	C03	I PINTC#	P01	O SUSAN# / GPO1
J03	I ACBTCLK	T04	IOD EXTSMI# / GPI2	W09	IO MEMR#	C02	I PINTD#	P02	O SUSB# / 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 ACSDIN0	U05	I FERR#	E19	I MRXD0 / AIRO	D02	O PREOL#	N05	O SUSST1# / GPO3
H02	I ACSDIN1	F06	IO FRAME#	E18	I MRXD1	U02	I PWRBTN#	B07	IO TRDY#
H03	O ACSDOOUT	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/AIRO	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/AIRO	Y16	IO SA03 / SDD03	B19	IO USBP1+
C09	IO AD12	F04	I GPIO	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/SCIOU#	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 HDSEL#	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 HREO1#/SD08/I10	Y06	O PCS0#/O16/strap	Y17	IO SA13 / SDD13	F15	P VCC
E05	IO AD22	V11	I HREO2#/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 BATTERY# / 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 CPUSTP# / 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 DRVVDEN0	W07	IO LAD2	R17	IO PDD14	R04	O SLOWCLK / O0	L16	P VCCPLL
K17	OD DRVVDEN1	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 PDIOW#	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 PINT# / 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	Address/Data Bus. 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	Command/Byte Enable. The command is driven with FRAME# assertion. Byte enables corresponding to supplied or requested data are driven on following clocks.																														
FRAME#	F6	IO	Frame. 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	Initiator Ready. Asserted when the initiator is ready for data transfer.																														
TRDY#	B7	IO	Target Ready. Asserted when the target is ready for data transfer.																														
STOP#	D7	IO	Stop. Asserted by the target to request the master to stop the current transaction.																														
DEVSEL#	A7	IO	Device Select. 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	Parity. A single parity bit is provided over AD[31:0] and C/BE[3:0]#.																														
SERR#	E7	I	System Error. 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	<p>PCI Interrupt Request. These pins are typically connected to the PCI bus INTA#-INTD# pins as follows:</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>PINTA#</u></th> <th style="text-align: center;"><u>PINTB#</u></th> <th style="text-align: center;"><u>PINTC#</u></th> <th style="text-align: center;"><u>PINTD#</u></th> </tr> </thead> <tbody> <tr> <td>PCI Slot 1</td> <td style="text-align: center;">INTA#</td> <td style="text-align: center;">INTB#</td> <td style="text-align: center;">INTC#</td> <td style="text-align: center;">INTD#</td> </tr> <tr> <td>PCI Slot 2</td> <td style="text-align: center;">INTB#</td> <td style="text-align: center;">INTC#</td> <td style="text-align: center;">INTD#</td> <td style="text-align: center;">INTA#</td> </tr> <tr> <td>PCI Slot 3</td> <td style="text-align: center;">INTC#</td> <td style="text-align: center;">INTD#</td> <td style="text-align: center;">INTA#</td> <td style="text-align: center;">INTB#</td> </tr> <tr> <td>PCI Slot 4</td> <td style="text-align: center;">INTD#</td> <td style="text-align: center;">INTA#</td> <td style="text-align: center;">INTB#</td> <td style="text-align: center;">INTC#</td> </tr> <tr> <td>PCI Slot 5</td> <td style="text-align: center;">INTA#</td> <td style="text-align: center;">INTB#</td> <td style="text-align: center;">INTC#</td> <td style="text-align: center;">INTD#</td> </tr> </tbody> </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	PCI Request. This signal goes to the North Bridge to request the PCI bus.																														
PGNTH#	D3	I	PCI Grant. This signal is driven by the North Bridge to grant PCI access to the VT8231.																														
PREQL#	D2	O	PCI Request. This signal goes to the North Bridge to request the PCI bus.																														
PGNTL#	D1	I	PCI Grant. This signal is driven by the North Bridge to grant PCI access to the VT8231.																														
PCICLK	M17	I	PCI Clock. PCLK provides timing for all transactions on the PCI Bus.																														
PCKRUN#	V1	IO	PCI Bus Clock Run. 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	PCI Reset.																														
PCISTP# / GPO6	W1	O	PCI Stop.																														
CPUSTP# / GPO5	W2	O	CPU Stop.																														

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

Note: Connect each of the above signals to 4.7K Ω pullup resistors to VCC3.

Strap Options			
Signal Name	Pin #	I/O	Signal Description
Strap / SUSA#	P1	I / O	CPURST / INIT Polarity H: L:
Strap / MCCS#	W6	I / O	CPU Frequency Strapping H: Disable L: Enable
Strap / PCS0#	Y6	I / O	SD Bus Width H: 16-Bit L: 8-Bit
Strap / SA16	Y14	I / IO	BIO ROM Interface H: LPC L: Conventional
Strap / SA17	T13	I / IO	Auto Reboot H: Disable L: Enable
Strap / KBCS# / ROMCS#	T9	I / O / O	CPU Type 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	Internal APIC Write Snoop Complete. 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. External APIC Request. 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	Internal APIC Data 0. External APIC Chip Select. 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	Internal APIC Data 1. External APIC Acknowledge. 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	APIC Clock.
SCIOUT# / GPIOD / GPIO30 / DTEST	Y1	O / IO IO / O	SCI Out. 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	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MCRS	G16	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MRXCLK	E17	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MRXD0	E19	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MRXDV	E20	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MRXERR	F18	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MTXCLK	F16	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MTXD0	F20	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MTXD1	G18	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MTXD2	G19	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MTXD3	G20	O	APIC IRQ. Internal condition for connection to external APIC.
AIRQ / MTXENA	F19	O	APIC IRQ. Internal condition for connection to external APIC.

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

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

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

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

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

System Management Bus (SMB) Interface (I²C Bus)			
Signal Name	Pin #	I/O	Signal Description
SMBCK1	R3	IO	SMB / I²C Channel 1 Clock.
SMBCK2 / GPIO27	R1	IO / IO	SMB / I²C Channel 2 Clock.
SMBDT1	T1	IO	SMB / I²C Channel 1 Data.
SMBDT2 / GPIO26	R2	IO / IO	SMB / I²C Channel 2 Data.
SMBALRT# / GPI7	T2	I / I	SMB Alert. (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

UltraDMA-33 / 66 Enhanced IDE Interface			
Signal Name	Pin #	I/O	Signal Description
PDRDY / PDDMARDY / PDSTROBE	N19	I	EIDE Mode: Primary I/O Channel Ready. Device ready indicator UltraDMA Mode: Primary Device DMA Ready. Output flow control. The device may assert DDMARDY to pause output transfers Primary Device Strobe. Input data strobe (both edges). The device may stop DSTROBE to pause input data transfers
SDRDY / SDDMARDY / SDSTROBE	Y20	I	EIDE Mode: Secondary I/O Channel Ready. Device ready indicator UltraDMA Mode: Secondary Device DMA Ready. Output flow control. The device may assert DDMARDY to pause output transfers Secondary Device Strobe. Input data strobe (both edges). The device may stop DSTROBE to pause input data transfers
PDIOR# / PHDMARDY / PHSTROBE	N18	O	EIDE Mode: Primary Device I/O Read. Device read strobe UltraDMA Mode: Primary Host DMA Ready. Primary channel input flow control. The host may assert HDMARDY to pause input transfers Primary Host Strobe. Output data strobe (both edges). The host may stop HSTROBE to pause output data transfers
SDIOR# / SHDMARDY / SHSTROBE	W19	O	EIDE Mode: Secondary Device I/O Read. Device read strobe UltraDMA Mode: Secondary Host DMA Ready. Input flow control. The host may assert HDMARDY to pause input transfers Host Strobe B. Output strobe (both edges). The host may stop HSTROBE to pause output data transfers
PDIOW# / PSTOP	P20	O	EIDE Mode: Primary Device I/O Write. Device write strobe UltraDMA Mode: Primary Stop. 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.
SDIOW# / SSTOP	Y19	O	EIDE Mode: Secondary Device I/O Write. Device write strobe UltraDMA Mode: Secondary Stop. 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.
PDDRQ	P19	I	Primary Device DMA Request. Primary channel DMA request
SDDRQ	U17	I	Secondary Device DMA Request. Secondary channel DMA request
PDDACK#	N20	O	Primary Device DMA Acknowledge. Primary channel DMA acknowledge
SDDACK#	W20	O	Secondary Device DMA Acknowledge. Secondary channel DMA acknowledge
IRQ14	T14	I	Primary Channel Interrupt Request.
IRQ15	U14	I	Secondary Channel Interrupt Request.

UltraDMA-33 / 66 Enhanced IDE Interface (continued)			
Signal Name	Pin #	I/O	Signal Description
PDCS1#	L18	O	Primary Master Chip Select. This signal corresponds to CS1FX# on the primary IDE connector.
PDCS3#	L19	O	Primary Slave Chip Select. This signal corresponds to CS3FX# on the primary IDE connector.
SDCS1#	U18	O	Secondary Master Chip Select. This signal corresponds to CS17X# on the secondary IDE connector.
SDCS3#	U19	O	Secondary Slave Chip Select. This signal corresponds to CS37X# on the secondary IDE connector.
PDA[2-0]	M20, M18, M19	O	Primary Disk Address. 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	Secondary Disk Address. 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	Primary Disk Data
SDD[15-0] / SA[15-0]	W18, V17, Y17, W16, V15, Y15, W14, T15, U15, U16, V14, W15, Y16, V16, W17, Y18	IO	Secondary Disk Data (SPKR strap 4.7K ohms low) <u>or</u> ISA Address (SPKR strap 4.7K ohms high)

MIDI Interface			
Signal Name	Pin #	I/O	Signal Description
MSI / I2S	G4	I / I	MIDI Serial In
MSO / SPDIF	J4	O / O	MIDI Serial Out

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

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

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

See Function 0 Rx77[6]

Floppy Disk Interface			
Signal Name	Pin #	I/O	Signal Description
DRVDEN0	L17	OD	Drive Density Select 0.
DRVDEN1	K17	OD	Drive Density Select 1.
MTR0#	K18	OD	Motor Control 0. Select motor on drive 0.
MTR1#	J16	OD	Motor Control 1. Select motor on drive 1
DS0#	J17	OD	Drive Select 0. Select drive 0.
DS1#	K19	OD	Drive Select 1. Select drive 1
DIR#	K20	OD	Direction. Direction of head movement (0 = inward motion, 1 = outward motion)
STEP#	J18	OD	Step. Low pulse for each track-to-track movement of the head.
INDEX#	L20	I	Index. Sense to detect that the head is positioned over the beginning of a track
HDSEL#	H19	OD	Head Select. Selects the side for R/W operations (0 = side 1, 1 = side 0)
TRK00#	H16	I	Track 0. Sense to detect that the head is positioned over track 0.
RDATA#	H20	I	Read Data. Raw serial bit stream from the drive for read operations.
WDATA#	J19	OD	Write Data. Encoded data to the drive for write operations.
WGATE#	J20	OD	Write Gate. Signal to the drive to enable current flow in the write head.
DSKCHG#	H18	I	Disk Change. Sense that the drive door is open or the diskette has been changed since the last drive selection.
WRTPRT#	H17	I	Write Protect. 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	Initialize. Initialize printer. Output in standard mode, I/O in ECP/EPP mode.
STROBE# / nc	A11	IO / -	Strobe. Output used to strobe data into the printer. I/O in ECP/EPP mode.
AUTOFD# / DRVEN0	E11	IO / O	Auto Feed. 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	Select In. Output used to select the printer. I/O pin in ECP/EPP mode.
SLCT / WGATE#	E13	I / O	Select. Status output from the printer. High indicates that it is powered on.
ACK# / DS1#	B14	I / O	Acknowledge. 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	Error. Status output from the printer. Low indicates an error condition in the printer.
BUSY / MTR1#	A14	I / O	Busy. Status output from the printer. High indicates not ready to accept data.
PE / WDATA#	D13	I / O	Paper End. Status output from the printer. High indicates that it is out of paper.
PD7 / nc, PD6 / nc, PD5 / nc, PD4 / DSKCHG#, PD3 / RDATA#, PD2 / WRTprt#, PD1 / TRK00#, PD0 / INDEX#	C14 A13 B13 C13 E12 A12 C12 D11	IO / - IO / - IO / - IO / I IO / I IO / I IO / I 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
TXD	B15	O	Transmit Data. Serial port transmit data out.
RXD	E14	I	Receive Data. Serial port receive data in.
IRTX / GPO14	R8	O / O	Infrared Transmit. IR transmit data out (Rx76[5] = 0) selectable from serial port 1, 2, or 3. General Purpose Output 14 if Rx76[5] = 1
IRRX / GPO15	U8	I / O	Infrared Receive. IR receive data in (Rx76[5] = 0) selectable to serial port 1, 2, or 3. General Purpose Output 15 if Rx76[5] = 1
IRRX2 / GPI	T8	I / I	Infrared Receive. IR receive data in (Rx76[5] = 0)
RTS#	A15	O	Request To Send. 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.
CTS#	B16	I	Clear To Send. 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.
DTR#	A16	O	Data Terminal Ready. 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.
DSR#	D14	I	Data Set Ready. 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.
DCD#	F14	I	Data Carrier Detect. 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.
RI#	C16	I	Ring Indicator. 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).

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

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

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

Chip Selects			
Signal Name	Pin #	I/O	Signal Description
ROMCS# / KBCS# / strap	T9	O / O / I	ROM Chip Select (Rx5A[0]=1). Chip Select to the BIOS ROM.
MCCS# / GPO17 / strap	W6	O / IO	Microcontroller Chip Select (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	Programmable Chip Select 0 . (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	Programmable Chip Select 1 .

General Purpose Inputs			
Signal Name	Pin #	I/O	Signal Description
GPI0	F4	I	General Purpose Input 0
GPI1 / IRQ8#	V3	I / I	General Purpose Input 1 (Rx5A[2] = 1)
GPI2 / EXTSMI#	T4	I / IO	General Purpose Input 2
GPI3 / RING#	U3	I / I	General Purpose Input 3
GPI4 / LID	Y2	I / I	General Purpose Input 4
GPI5 / BATLOW#	T3	I / I	General Purpose Input 5
GPI6 / PME#	U1	I / I	General Purpose Input 6
GPI7 / SMBALRT#	T2	I / I	General Purpose Input 7
GPI8 / INTRUDER#	F3	I / I	General Purpose Input 8
GPI9 / APICCLK	Y3	I / I	General Purpose Input 9
GPI10 / SD8 / HREQ1#	Y11	I / IO / I	General Purpose Input 10
GPI11 / SD10 / HREQ2#	W11	I / IO / I	General Purpose Input 11
GPI12 / SD12 / LREQ1#	U10	I / IO / I	General Purpose Input 12
GPI13 / SD14 / LREQ2#	W10	I / IO / I	General Purpose Input 13
GPI14 / WSC# / APICREQ#	V4	I / I / I	General Purpose Input 14
GPI15 / LDRQ# / ACSIN3	Y8	I / I / I	General Purpose Input 15
GPI16 / CPUMISS	R5	I / I	General Purpose Input 16
GPI17 / AOLGPI / THRM	P3	I / I / I	General Purpose Input 17
GPI18 / GPO18 / FAN2 / SLPBTN#	K3	I / O / I / I	General Purpose Input 18
GPI19 / GPO19 / ACSIN2 / PCS1#	J1	I / O / I / O	General Purpose Input 19
GPI20			General Purpose Input 20
GPI21			General Purpose Input 21
GPI22			General Purpose Input 22
GPI23			General Purpose Input 23
GPI24 / GPO24 / GPIOA	V2	I / O / IO	General Purpose Input 24
GPI25 / GPO25 / GPIOC / ATEST	J2	I / O / IO / O	General Purpose Input 25
GPI26 / GPO26 / SMBDT2	R2	I / O / IO	General Purpose Input 26
GPI27 / GPO27 / SMBCK2	R1	I / O / IO	General Purpose Input 27
GPI28 / GPO28 / APICD0 / APICCS#	W4	I / O / O / O	General Purpose Input 28
GPI29 / GPO29 / APICD1 / APICACK#	Y4	I / O / O / O	General Purpose Input 29
GPI30 / GPO30 / GPIOD / DTEST / SCIOUT#	Y1	I / O / IO / O / O	General Purpose Input 30
GPI31 / GPO31 / GPIOE	W3	I / O / IO	General Purpose Input 31

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

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

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

Power Management and External State Monitoring			
Signal Name	Pin #	I/O	Signal Description
PME# / GPI6	U1	I / I	Power Management Event. (Rx74[1]=0) (1K PU to VCCS if not used)
EXTSMI# / GPI2	T4	IOD / I	External System Management Interrupt. 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)
SMBALRT# / GPI7	T2	I / I	SMB Alert (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)
THRM / AOLGPI / GPI17	P3	I / I / I	Monitor Input - Thermal Alarm. (Rx74[1]=1) (1K PU to VCCS if not used)
LID / GPI4	Y2	I / I	Monitor Input - Notebook Computer Display Lid Open / Closed. 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)
RING# / GPI3	U3	I / I	Monitor Input - Modem Ring. 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)
BATLOW# / GPI5	T3	I / I	Monitor Input - Battery Low. (10K PU to VCCS if not used)
CPUMISS / GPI16	R5	I / I	Monitor Input - CPU Missing. Indicates whether the CPU is plugged in correctly.
AOLGPI / GPI17 / THRM	P3	I / I / I	Monitor Input - Awake On LAN External Event.
INTRUDER# / GPI8	F3	I / I	Monitor Input - Chassis Intrusion.
RSMRST#	F5	I	Resume Reset. Resets the internal logic connected to the VCCS power plane and also resets portions of the internal RTC logic.
SUSA# / GPO1 / strap	P1	O / O / I	Suspend Plane A Control (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)
SUSB# / GPO2	P2	O / O	Suspend Plane B Control (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)
SUSC# / GPO	N3	O / O	Suspend Plane C Control. Asserted during power management STD suspend state. Used to control the tertiary power plane. Also connected to ATX power-on circuitry.
SUSST1# / GPO3	N5	O / O	Suspend Status 1 (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.
SUSCLK / GPO4	P4	O / O	Suspend Clock. 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
PWRGD	E3	I	Power Good. Connected to the PWRGOOD signal on the Power Supply.
PWRBTN#	U2	I	Power Button. 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)
SLPBTN# / FAN2 / GPIO18	K3	I / I / IO	Sleep Button. 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.
PCIRST#	E4	O	PCI Reset. Active low reset signal for the PCI bus. The VT8231 will assert this pin during power-up or from the control register.
RTCX1	E2	I	RTC Crystal Input: 32.768 KHz crystal or oscillator input. This input is used for the internal RTC and for power-well power management logic.
RTCX2	E1	O	RTC Crystal Output: 32.768 KHz crystal output
OSC	T12	I	Oscillator. 14.31818 MHz clock signal used by the internal Timer.
SLOWCLK / GPO0	R4	O	Slow Clock. Frequency selectable if PMU function 4 Rx54[1-0] is nonzero (set to 01, 10, or 11).
CPUSTP# / GPO5	W2	O / O	CPU Clock Stop (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].
PCISTP# / GPO6	W1	O / O	PCI Clock Stop (Rx75[5] = 0). Signals the system clock generator to disable the PCI clock outputs. Not connected if not used.

Power and Ground			
Signal Name	Pin #	I/O	Signal Description
VCC (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	Core Power. 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.
GND (27 Pins)	G7, G11, G14, H15, J8-J13, K6, K8-K13, L8-L13, L15, M8-M13, N15, P7, P10, P14	P	Ground. Connect to primary motherboard ground plane.
VCCSUS	P5, P6	P	Suspend Power. 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#, SUSCS#, 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
VBAT	F2	P	RTC Battery. Battery input for internal RTC. Signals powered by or referenced to this plane are: RTCX1, RTCX2, PWRGD, RSMRST#, GPIO, and INTRUDER#.
VREF	K1	P	Voltage Reference (5V ±5%). For thermal sensing and 5V input tolerance.
VCCHWM	M5	P	Hardware Monitor Power. 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
GNDHWM	L5	P	Hardware Monitor Ground. Connect to GND through a ferrite bead.
VCCMII	F16, K16	P	LAN MII Power. 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]
VCCRAM	G15	P	LAN RAM Power. Power for LAN internal RAM. Connect to VCC through a ferrite bead.
GNDRAM	G13	P	LAN RAM Ground. Connect to GND through a ferrite bead.
VCCPLL	L16	P	PLL Power. Power for internal PLL. Connect to VCC through a ferrite bead.
GNDPLL	M16	P	PLL Ground. Connect to GND through a ferrite bead.
VCCUSB	E15	P	USB Differential Output Power. Power for USB differential outputs (USBP0+, P0-, P1+, P1-, P2+, P2-, P3+, P3-). Connect to VCC through a ferrite bead.
GNDUSB	D15	P	USB Differential Output Ground. 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 xnxn
(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

Port	Master DMA Controller Registers	Default	Acc
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

Port	Master Interrupt Controller Regs	Default	Acc
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

Port	Timer/Counter Registers	Default	Acc
40	Timer / Counter 0 Count		RW
41	Timer / Counter 1 Count		RW
42	Timer / Counter 2 Count		RW
43	Timer / Counter Control		WO

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

Port	CMOS / RTC / NMI Registers	Default	Acc
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)

Port	DMA Page Registers	Default	Acc
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

Port	System Control Registers	Default	Acc
92	System Control		RW

Port	Slave Interrupt Controller Regs	Default	Acc
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

Port	Slave DMA Controller Registers	Default	Acc
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	1106	RO
3-2	Device ID	8231	RO
5-4	Command	0087	RW
7-6	Status	0200	WC
8	Revision ID	nn	RO
9	Programming Interface	00	RO
A	Sub Class Code	01	RO
B	Base Class Code	06	RO
C	-reserved- (cache line size)	00	—
D	-reserved- (latency timer)	00	—
E	Header Type	80	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	01	RW
49	-reserved-	00	—
4A	IDE Interrupt Routing	04	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	0300	RW

Offset	Plug and Play Control	Default	Acc
50	PnP DMA Request Control	2D	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-	04	—
5A	KBC / RTC Control	x4 †	RW
5B	Internal RTC Test Mode	00	RW
5C	DMA Control	00	RW
5D-5E	-reserved-	00	—
5F	-reserved- (do not program)	04	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	PCS2/3 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	1106	RO
3-2	Device ID	0571	RO
5-4	Command	0080	RO
7-6	Status	0280	RW
8	Revision ID	nn	RO
9	Programming Interface	85	RW
A	Sub Class Code	01	RO
B	Base Class Code	01	RO
C	-reserved- (cache line size)	00	—
D	Latency Timer	00	RW
E	Header Type	00	RO
F	Built In Self Test (BIST)	00	RO
13-10	Base Address – Pri Data / Command	000001F0	RO
17-14	Base Address – Pri Control / Status	000003F4	RO
1B-18	Base Address – Sec Data / Command	00000170	RO
1F-1C	Base Address – Sec Control / Status	00000374	RO
23-20	Base Address – Bus Master Control	0000CC01	RW
24-2F	-reserved- (unassigned)	00	—
30-33	-reserved- (expan ROM base addr)	00	—
34	Capability Pointer	C0	RO
35-3B	-reserved- (unassigned)	00	—
3C	Interrupt Line	0E	RW
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	08	RW
41	IDE Configuration	02	RW
42	-reserved- (do not program)	09	RW
43	IDE FIFO Configuration	3A	RW
44	IDE Miscellaneous Control 1	68	RW
45	IDE Miscellaneous Control 2	03	RW
46	IDE Miscellaneous Control 3	C0	RW
4B-48	IDE Drive Timing Control	A8A8A8A8	RW
4C	IDE Address Setup Time	FF	RW
4D	-reserved- (do not program)	00	RW
4E	Sec Non-1F0 IDE Port Access Timing	FF	RW
4F	Pri Non-1F0 IDE Port Access Timing	FF	RW

Configuration Space IDE-Specific Registers (continued)

Offset	Configuration Space IDE Registers	Default	Acc
53-50	UltraDMA Extended Timing Control	03030303	RW
54	UltraDMA FIFO Control	06	RW
55-5F	-reserved-	00	—
61-60	IDE Primary Sector Size	0200	RW
62-67	-reserved-	00	—
69-68	IDE Secondary Sector Size	0200	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	0201	RO
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	WC
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	WC
B	-reserved-	00	—
C-F	Secondary Channel PRD Table Addr	00	RW

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

Configuration Space USB Header Registers

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

Configuration Space USB-Specific Registers

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

Configuration Space USB-Specific Registers

Offset	USB Control	Default	Acc
40	USB Miscellaneous Control 1	00	RW
41	USB Miscellaneous Control 2	10	RW
42	USB FIFO Control	00	RW
43	-reserved-	00	RO
44-45	-reserved- (test only, do not program)		RW
46-47	-reserved- (test)		RO
48-5F	-reserved-	00	—
60	USB Serial Bus Release Number	10	RO
61-7F	-reserved-	00	—
83-80	PM Capability	0002 0001	RO
84	PM Capability Status	00	RW
85-BF	-reserved-	00	—
C1-C0	USB Legacy Support	2000	RW
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	WC
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	40	RW
11-10	Port 0 Status / Control	0080	WC
13-12	Port 1 Status / Control	0080	WC
14-1F	-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	WC
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	40	RW
11-10	Port 2 Status / Control	0080	WC
13-12	Port 3 Status / Control	0080	WC
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	1106	RO
3-2	Device ID	3068	RO
5-4	Command	0000	RO
7-6	Status	0280	WC
8	Revision ID	nn	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	—	RO
45-44	Primary Interrupt Channel	0000	RW
47-46	Secondary Interrupt Channel	0000	RW
4B-48	Power Mgmt I/O Base (256 Bytes)	0000 0001	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	WO
62	Write value for Offset A (Sub Class)	00	WO
63	Write value for Offset B (Base Class)	00	WO
64-7F	-reserved-	00	—

Configuration Space Hardware Monitor Registers

Offset	System Management Bus	Default	Acc
71-70	Hardware Mon IO Base (128 Bytes)	0001	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)	0000 0001	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	nn	RO
D7-FF	-reserved-	00	—

I/O Space Power Management- Registers

Offset	Basic Control / Status Registers	Default	Acc
1-0	Power Management Status	0000	WC
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	RO
15	Processor LVL3	00	RO
16-1F	-reserved-	00	—

Offset	General Purpose Registers	Default	Acc
21-20	General Purpose Status	0000	WC
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	WC
2B-2A	Global Enable	0000	RW
2D-2C	Global Control	0010	RW
2E	-reserved-	00	—
2F	SMI Command	00	RW
33-30	Primary Activity Detect Status	0000 0000	WC
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	WC
41	-reserved-	00	—
42	Extended I/O Trap Enable	00	RW
43	-reserved-	00	—
44	External SMI / GPI Input Value	input	RO
45	SMI / IRQ / Resume Status	00	RO
46-47	-reserved-	00	—
4B-48	GPI Port Input Value	input	RO
4F-4C	GPO Port Output Value	03FF FFFF	RW
50-FF	-reserved-	00	—

I/O Space System Management Bus Registers

Offset	System Management Bus	Default	Acc
0	SMBus Host Status	00	WC
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	RO
A-B	SMBus Slave Event	0000	RW
C-D	SMBus Slave Data	0000	RO
E-F	-reserved-	00	—

I/O Space Hardware Monitor Registers

Offset	Hardware Monitor	Default	Acc
00-3F	<u>Value RAM</u>		
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	08	RW
41	Hardware Monitor Interrupt Status 1	00	RO
42	Hardware Monitor Interrupt Status 2	00	RO
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	50	RW
48	-reserved-	00	—
49	HW Mon Temp Value Lo-Order Bits	00	RW
4A	-reserved-	00	—
4B	Temperature Interrupt Configuration	15	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	1106	RO
3-2	Device ID	3058	RO
5-4	Command	0000	RW
7-6	Status	0210	WC
8	Revision ID	40	RO
9	Programming Interface	00	RO
A	Sub Class Code	01	RO
B	Base Class Code	04	RO
C	Cache Line Size	00	RO
D	Latency Timer	00	RW
E	Header Type	00	RO
F	BIST	00	RO
13-10	Base Address 0 - SGD Control/Status	0000 0001	RW
17-14	Base Address 1 - FM NMI Status	0000 0001	RW
1B-18	Base Address 2 - MIDI Port	0000 0331	RW
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	RW
33-30	Expansion ROM (reserved)	0000 0000	—
34	Capture Pointer	00	RW
35-3B	-reserved-	00	—
3C	Interrupt Line	00	RW
3D	Interrupt Pin	03	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	RO
41	AC-Link Interface Control	00	RW
42	Function Enable	00	RW
43	Plug and Play Control	1C	RW
44	MC97 Interface Control	00	RO
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	1106	RO
3-2	Device ID	3068	RO
5-4	Command	0000	RW
7-6	Status	0200	WC
8	Revision ID	40	RO
9	Programming Interface	00	RO
A	Sub Class Code	80	RO
B	Base Class Code	07	RO
C	Cache Line Size	00	RO
D	Latency Timer	00	RW
E	Header Type	00	RO
F	BIST	00	RO
13-10	Base Address 0 - SGD Control/Status	0000 0001	RW
17-14	Base Address 1 - (reserved)	0000 0000	RW
1B-18	Base Address 2 - (reserved)	0000 0000	RW
1F-1C	Base Address 3 – Codec Reg Shadow	0000 0001	—
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	RW
33-30	Expansion ROM (reserved)	0000 0000	—
34	Capture Pointer	00	RW
35-3B	-reserved-	00	—
3C	Interrupt Line	00	RW
3D	Interrupt Pin	03	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	RO
41	AC-Link Interface Control	00	RW
42	Function Enable	00	RO
43	Plug and Play Control	1C	RO
44	MC97 Interface Control	00	RW
45-47	-reserved-	00	—
48	FM NMI Control	00	RO
49	-reserved-	00	—
4B-4A	Game Port Base Address	0000	RO
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	WC
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 SGD DXSn Read Ch Current Address	0000 0000	WR RD
nB-n8	SGD DXSn Read Channel Format	0000 0000	RO
nF-nC	SGD DXSn Read Chan Index / Count	0000 0000	RO
40	SGD 3D Channel Status	00	WC
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 SGD 3D Channel Current Address	0000 0000	WR RD
4B-48	SGD 3D Channel Slot Select	0000 0000	RW
4F-4C	SGD 3D Channel Index / Count	0000 0000	RO
50	SGD FM Channel Status	00	WC
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 SGD FM Channel Current Address	0000 0000	WR RD
58-5B	-reserved-	00	—
5F-5C	SGD FM Channel Current Count	0000 0000	RO
60	SGD Write Channel 0 Status	00	WC
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 SGD Write Channel 0 Current Addr	0000 0000	WR RD
68-6B	-reserved-	00	—
6F-6C	SGD Write Channel 0 Current Count	0000 0000	RO
70	SGD Write Channel 1 Status	00	WC
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 SGD Write Channel 1 Current Addr	0000 0000	WR RD
78-7B	-reserved-	00	—
7F-7C	SGD Write Channel 1 Current Count	0000 0000	RO

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	RO
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	RO
1	FM NMI Data	00	RO
2	FM NMI Index	00	RO
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	WC
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 SGD Modem Read Ch Current Addr	0000 0000	WR RD
8-B	-reserved-	00	—
F-C	SGD Modem Read Ch Current Count	0000 0000	RO
10	SGD Modem Write Channel Status	00	WC
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 SGD Modem Wr Ch Current Address	0000 0000	WR RD
18-1B	-reserved-	00	—
1F-1C	SGD Modem Write Ch Current Count	0000 0000	RO

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	WC
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

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

Port	SB Pro Regs (same as offsets 8 & 9)	Default	Acc
388h	FM Index / Status		RW
389h	FM Data		WO

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

I/O Registers – Game Port

Offset	Game Port (200-20F typical)	Default	Acc
0	-reserved-	00	--
1	Game Port Status		RO
1	Start One-Shot		WO
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 Inaccessable** ..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:

Bit	Input Port	Lo Code	Hi Code
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	-	-

Bit	Output Port	Lo Code	Hi Code
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	-	-

Bit	Test Port	Lo Code	Hi Code
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 BufferRO

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

<u>Code</u>	<u>Keyboard Command Code Description</u>	<u>Code</u>	<u>Keyboard Command Code Description</u>
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 repeatedly & 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 (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) (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).

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

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>	
0000 0000 001x xxx0	Master Interrupt Control	RW
0000 0000 001x xxx1	Master Interrupt Mask	RW

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>	
0000 0000 101x xxx0	Slave Interrupt Control	RW
0000 0000 101x xxx1	Slave Interrupt Mask	RW

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).

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

Port 21 - Master Interrupt Mask Shadow **RO** |

Port A1 - Slave Interrupt Mask Shadow **RO** |

7-5	Reserved	always reads 0
4-0	T7-T3 of Interrupt Vector Address	

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>	
0000 0000 010x xx00	Timer / Counter 0 Count	RW
0000 0000 010x xx01	Timer / Counter 1 Count	RW
0000 0000 010x xx10	Timer / Counter 2 Count	RW
0000 0000 010x xx11	Timer / Counter Cmd Mode	WO

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).

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

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 Generationdefault
- 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 pm 12hr: 81-8Ch 24hr: 00-17h	01-12h 81-92h 00-23h
05	Hours Alarm	am 12hr: 01-1Ch pm 12hr: 81-8Ch 24hr: 00-17h	01-12h 81-92h 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 ConfigurationRW

- 7 Serial Port 2 High Speed Enable**
 - 0 Disabledefault
 - 1 Enable
- 6 Serial Port 1 High Speed Enable**
 - 0 Disabledefault
 - 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 Disabledefault
 - 1 Enable
- 1 Serial Port 2 TX Output Inversion**
 - 0 Disabledefault
 - 1 Enable
- 0 Serial Port 2 RX Input Inversion**
 - 0 Disabledefault
 - 1 Enable

Index EF – Power Down Control.....RW

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

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

- 7 PS2 Type BiDirectional 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) Modedefault
- 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 Disabledefault
- 1 Enable

3 Reserved always reads 0

2 Four Floppy Drive Option

- 0 Internal 2-Drive Decoderdefault
- 1 External 4-Drive Decoder

1 FDC DMA Non-Burst

- 0 Burstdefault
- 1 Non-Burst

0 FDC Swap

- 0 Disabledefault
- 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/set 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 Disabledefault
 - 1 Enable
- 3 Printer Select**
 - 0 Deselect printerdefault
 - 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 transferdefault
 - 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 BufferRW

7-0 Serial Data

Port COM1Base+1 – Interrupt EnableRW

- 7-4 Undefinedalways 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 StatusRO

- 7-3 Undefinedalways 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 BufferRW

7-0 Serial Data

Port COM1Base+1 – Interrupt EnableRW

- 7-4 Undefinedalways 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 StatusRO

- 7-3 Undefinedalways 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 / StatusRW

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 / StatusRW

7-0 FM Index / Status (Both Channels)

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

Mixer Registers

Port SBPBase+4 – Mixer Index..... WO

7-0 Mixer Index

Port SBPBase+5 – Mixer DataRW

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 DataRO

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

#	Type	Command
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

- 7 Joystick B Button 2 Status**
- 6 Joystick B Button 1 Status**
- 5 Joystick A Button 2 Status**
- 4 Joystick A Button 1 Status**
- 3 Joystick B One-Shot Status for Y-Potentiometer**
- 2 Joystick B One-Shot Status for X-Potentiometer**
- 1 Joystick A One-Shot Status for Y-Potentiometer**
- 0 Joystick A One-Shot Status for X-Potentiometer**

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 AddressRW

31 Configuration Space Enable

- 0 Disableddefault
- 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 DataRW

There are 7 "functions" implemented in the VT8231:

<u>Function #</u>	<u>Function</u>
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 Enabledefault
- 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 Disabledefault
 - 1 Enable
- 5 Master Request Test Mode (do not program)**
 - 0 Disabledefault
 - 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 Statesdefault
 - 1 1 Wait State
- 6 Gate INTR**
 - 0 Disabledefault
 - 1 Enable
- 5 Flush Line Buffer for Int or DMA IOR Cycle**
 - 0 Disabledefault
 - 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 Disabledefault
 - 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 Disabledefault
 - 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 memorydefault

Offset 4A - IDE Interrupt RoutingRW

- 7 **Wait for PGNT Before Grant to ISA Master / DMA**
 - 0 Disabledefault
 - 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# ControlRW

- 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 Enabledefault
- 1 **Internal PS2 Mouse Enable**
 - 0 Disabledefault
 - 1 Enable
- 0 **Internal KBC Enable**
 - 0 Disabledefault
 - 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:

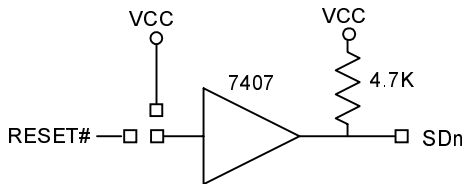


Figure 5. Strap Option Circuit

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 Disabledefault
 - 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 Disabledefault
 - 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 Disabledefault
 - 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 Disabledefault
 - 1 Enable
- 2-0 Reserved always reads 0

Offset 69-68 – Serial IRQ ControlRW

- 15-4 Reserved always reads 0
- 3 ISA IRQ Asserted Via Serial IRQ (Pin H3 or L4)
 - 0 Disabledefault
 - 1 Enable
- 2 Serial IRQ Mode
 - 0 Continuous Modedefault
 - 1 Quiet Mode
- 1-0 Serial IRQ Start-Frame Width
 - 00 4 PCI Clocksdefault
 - 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 Inputdefault
 - 1 Output (GPO11)
- 4 GPIOC Direction (Pin V14)**
 - 0 Inputdefault
 - 1 Output
- 3 GPIOB Direction (Pin U12)**
 - 0 Inputdefault
 - 1 Output
- 2 GPIOA Direction (Pin T14)**
 - 0 Inputdefault
 - 1 Output
- 1 THRM Enable (Pin T11)**
 - 0 PME# / GPI5 (see Func 4 Rx48[5])default
 - 1 THRM
- 0 GPIO / IOCHCK# Select**
 - 0 GPIOdefault
 - 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 CPUTP#..... 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 Disabledefault
 - 1 Enable
- 6 OC[3:0] From SD[3:0] By Scan**
 - 0 Disabledefault
 - 1 Enable
- 5 GPO14 / GPO15 Enable (Pins E12 / D12)**
 - 0 Pins used for IRTX and IRRXdefault
 - 1 Pins used for GPO14 and GPO15
- 4 MCCS# Pin Select**
 - 0 MCCS# is on Pin U5default
 - 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 GPIOAdefault
 - 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 Disabledefault
 - 1 Enable
- 6 Game Port XY Pins are GPI / GPO**
 - 0 Disabledefault
 - 1 Enable
- 5-4 Reserved** always reads 0
- 3 SERIRQ SMI Slot**
 - 0 Disabledefault
 - 1 Enable
- 2 RTC Rx32 Write Protect**
 - 0 Disabledefault
 - 1 Enable
- 1 RTC Rx0D Write Protect**
 - 0 Disabledefault
 - 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 1RW

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

Offset 82 – ISA Positive Decoding Control 2RW

- 7 FDC Positive Decoding**
 - 0 Disabledefault
 - 1 Enable
- 6 LPT Positive Decoding**
 - 0 Disabledefault
 - 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 Disabledefault
 - 1 Enable
- 2 MIDI Positive Decoding**
 - 0 Disabledefault
 - 1 Enable
- 1-0 MIDI Decode Range**
 - 00 300h-303hdefault
 - 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 EnableRW

- 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 Disabledefault
 - 1 Enable
- 0 **Super-I/O**
 - 0 Disabledefault
 - 1 Enable

Offset 86 – PNP IRO/DRO Test 1 (Do Not Program) ... RW

Offset 87 – PNP IRO/DRO Test 2 (Do Not Program) ... RW

Offset 88 – PLL TestRW

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

Offset 89 – PLL ControlRW

- 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):

Channel	Command Block	Control Block	IRQ
	Registers	Registers	
Pri	1F0-1F7	3F6	14
Sec	170-177	376	15

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

Channel	Command Block	Control Block
	Registers	Registers
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 Reservedalways 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 Reservedalways read 0
- 15-2 Port Address default=03F4h
- 1-0 Fixed at 01b fixed

Offset 1B-18 - Sec Data / Command Base AddressRW

Specifies an 8 byte I/O address space.

- 31-16 Reservedalways 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 Reservedalways 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 Reservedalways 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 Disabledefault
 - 1 Enable
- 2 **Memory Read and Invalidate Command**
 - 0 Disabledefault
 - 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 4Tdefault

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 Reservedalways 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 Reservedalways 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 Reservedalways 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 Reservedalways 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 Disableddefault
 - 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 Disableddefault

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 StatusRW

- 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 AddressRW

Offset 8B-88 – Secondary S/G Descriptor AddressRW

Offset C3-C0 – PCI PM Block 1RO

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

Offset C7-C4 – PCI PM Block 2RO

31-2 Reserved always reads 0

1-0 Power State

00 Ondefault

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 IDRO

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 Mediumdefault (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 framedefault
 - 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 managementdefault
 - 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 waitdefault
 - 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 StatusRW

- 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 IDRO

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 Mediumdefault (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 framedefault
 - 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 waitdefault
 - 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 StatusRW

- 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 IDRO

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 Steppingfixed at 0
- 6 Reserved (parity error response)fixed at 0
- 5 Reserved (VGA palette snoop)fixed at 0
- 4 Memory Write and Invalidatefixed at 0
- 3 Reserved (special cycle monitoring)fixed at 0
- 2 Bus Masterfixed at 0
- 1 Memory Space.....fixed at 0
- 0 I/O Spacefixed 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 Mediumdefault (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 0RW

- 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 Disabledefault
 - 1 Sleep Button is on IRQ6 pin (pin G1)
- 5 Debounce LID and PWRBTN# Inputs for 200us**
 - 0 Disabledefault
 - 1 Enable
- 4 Reserved** always reads 0
- 3 Microsoft Sound Monitor in Audio Access**
 - 0 Disabledefault
 - 1 Enable
- 2 Game Port Monitor in Audio Access**
 - 0 Disabledefault
 - 1 Enable
- 1 SoundBlaster Monitor in Audio Access**
 - 0 Disabledefault
 - 1 Enable
- 0 MIDI Monitor in Audio Access**
 - 0 Disabledefault
 - 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 SelectRW

- 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 Disableddefault
 - 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 Reservedalways 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 Reservedalways 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 BaseRW

- 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 Disabledefault
1 Enable
- 2 **Frame Input as Resume Event in C3**
0 Disabledefault
1 Enable
- 1 **Reserved** always reads 0
- 0 **CPU Stop Grant Cycle Select**
0 From Halt and Stop Grant Cycledefault
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:

Rx2C[3]	Rx4C[0]	CPUSTP# Assertion
0	x	Immediate
1	0	Wait for CPU Halt / Stop Grant cycle
1	1	Wait for CPU 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 seconddefault
 - 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 Disabledefault
 - 1 Enable

- 27-26 Secondary Event Timer Count Value**
 - 00 2 milliseconds.....default
 - 01 64 milliseconds
 - 10 1/2 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 Disabledefault
 - 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 0default
 - 1 Reload GP1 timer automatically after counting down to 0

- 5-4 GP1 Timer Base**
 - 00 Disabledefault
 - 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 Disabledefault
 - 1 Enable
- 5 SUSC# = 0 for STR**
 - 0 Disabledefault
 - 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 ControlRW

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 0default
- 1 Reload GP3 timer automatically after counting down to 0

5-4 GP3 Timer Tick Select

- 00 Disabledefault
- 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 0default
- 1 Reload GP2 timer automatically after counting down to 0

1-0 GP2 Timer Tick Select

- 00 Disabledefault
- 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 BaseRW

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

Offset 74 –Hardware Monitor ControlRW

- 7-4 Reserved always reads 0
- 3 **Hardware Monitoring Interrupt**
 - 0 SMIdefault
 - 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 StatusRWC

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 23rd (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 ControlRW

- 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 stoppeddefault
 - 1 CPU clock is stopped in the C3 state
- 8 Assert SLP# for Processor Level 3 Read**
 - 0 Disabledefault
 - 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 Disabledefault
 - 1 Enable
- 10 **IDE Primary Bus Power-Off**
 - 0 Disabledefault
 - 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 Edgedefault
 - 1 Falling Edge
- 6 **THRM# Triggering Polarity**
 - 0 Rising Edgedefault
 - 1 Falling Edge
- 5 **Battery Low Resume Disable**
 - 0 Enable resumedefault
 - 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 edgedefault
 - 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.

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 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 PrimaryIDE 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

I/O Offset 3B-38 - GP Timer Reload EnableRW

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 Operationdefault
 - 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 Operationdefault
 - 1 Setting of VGA_STS causes the GP1 timer to reload.
- 3 GP1 Timer Reload on IDE/Floppy Access**
 - 0 Normal GP1 Timer Operationdefault
 - 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 Operationdefault
 - 1 Setting of GR1_STS causes the GP3 timer to reload.
- 1 GP2 Timer Reload on GPIO Range 0 Access**
 - 0 Normal GP2 Timer Operationdefault
 - 1 Setting of GR0_STS causes the GP2 timer to reload.
- 0 GP0 Timer Reload on Primary Activity**
 - 0 Normal GP0 Timer Operationdefault
 - 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 Ramge 3 Access Status (GPR3_STS)**
- 0 GPIO Ramge 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 Ramge 3 Access.....(GPR3_EN)**
 - 0 Disable..... default
 - 1 Enable
- 0 SMI on GPIO Ramge 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 StatusRO

- 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 Valuedef = 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 transactiondefault
 - 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 BusyRO**
 - 0 SMBus controller host interface is not processing a commanddefault
 - 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 effectdefault
 - 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 Writedefault
 - 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 operationdefault
 - 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 generationdefault
 - 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 Disabledefault
 - 1 Enable generation of an interrupt or resume event on the assertion of the SMBALERT# signal
- 2 **SMBus Shadow Port 2 Enable**
 - 0 Disabledefault
 - 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 Disabledefault
 - 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 Disabledefault
 - 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 15-8RW

Offset 14 – Analog Data 7-0RW

Offset 15 – Digital Data 7-0RW

Offset 16 – Channel Counter.....RW

Offset 17 – Data Valid & Channel Indicators.....RW

Offset 1D – TSENS3 Hot Temperature High LimitRW

Offset 1E – TSENS3 Hot Temp Hysteresis Lo Limit.....RW

Offset 1F – TSENS3 Temperature ReadingRW

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 ReadingRW

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 ReadingRW

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 11111111b), 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 ConfigurationRW

7 Initialization

- 0 Normal operationdefault
- 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 operationdefault
- 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 servicedefault

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 2default
 - 10 Divide by 4
 - 11 Divide by 8
- 5-4 Fan 1 RPM Control**
 - 00 Divide by 1
 - 01 Divide by 2default
 - 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 Disabledefault
 - 1 Enable
- 2 Chassis Active Low Output 20 msec**
 - 0 Disabledefault
 - 1 Enable
- 1 Interrupt Active High Output**
 - 0 Disabledefault
 - 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 IDRO

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 Steppingfixed at 0
- 6 Parity Error Response.....fixed at 0
- 5 VGA Palette Snoopfixed at 0
- 4 Memory Write and Invalidatefixed at 0
- 3 Special Cycle Monitoringfixed at 0
- 2 Bus Masterfixed 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 Abortfixed 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 1.1fixed 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 IDRO

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 Steppingfixed at 0
- 6 Parity Error Response.....fixed at 0
- 5 VGA Palette Snoopfixed at 0
- 4 Memory Write and Invalidatefixed at 0
- 3 Special Cycle Monitoringfixed at 0
- 2 Bus Masterfixed 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 Abortfixed 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 Reservedalways reads 0
- 15-8 Base Address..... default = 00h
- 7-0 0000001b (256 bytes)

Offset 1F-1C - Base Address 3 – Codec Reg Shadow RW

- 31-16 Reservedalways reads 0
- 15-8 Base Address..... default = 00h
- 7-0 0000001b (256 bytes)

Offset 3C - Interrupt Line..... RW

- 7-4 Reservedalways 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 StatusRO

- 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 StatusRO**
 - 0 Codec Not Ready
 - 1 Codec Ready (AC97 ctrlr can access codec)
- 1 **Secondary Codec 1 (CID=01b) Ready StatusRO**
 - 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 EnableRW (Function 5)

Offset 42 – Function EnableRO (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 Disabledefault
 - 1 Enable
- 5 Function 5 Config Reg Rx2C Writable**
 - 0 F5Rx2C-2F ROdefault
 - 1 F5Rx2C-2F RW
- 4 Gate SoundBlaster PCM When FIFO Empty**
 - 0 Disabledefault
 - 1 Enable
- 3 Game Port Enable (ENGAME)**
 - 0 Disabledefault
 - 1 Enable (200-207h)
- 2 FM Enable (ENFM)**
 - 0 Disabledefault
 - 1 Enable (388-38B)
- 1 MIDI Enable (ENMIDI)**
 - 0 Disabledefault
 - 1 Enable
- 0 SoundBlaster Enable (ENSB)**
 - 0 Disabledefault
 - 1 Enable

Offset 43 – Plug and Play ControlRW (Function 5)

Offset 43 – Plug and Play ControlRO (Function 6)

- 7-6 SoundBlaster IRQ Select (SBIRQS[1:0])**
 - 00 IRQ5default
 - 01 IRQ7
 - 10 IRQ9
 - 11 IRQ10
- 5-4 SoundBlaster DRQ Select (SBDRQS[1:0])**
 - 00 DMA Channel 0
 - 01 DMA Channel 1default
 - 10 DMA Channel 2
 - 11 DMA Channel 3
- 3-2 MIDI Decode Select (MIDIBASE)**
 - 00 300-303h
 - 01 310-313h
 - 10 320-323h
 - 11 330-333hdefault
- 1-0 SoundBlaster Decode Select (SBBASE)**
 - 00 220-22Fhdefault
 - 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 StatusRWC

- 7 SGD Active (0 = completed or terminated).....RO
- 6-3 Reserved always reads 0
- 2 SGD StoppedRO
- 1 SGD EOLRWC
- 0 SGD FlagRWC

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 Disabledefault
 - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
 - 0 Disabledefault
 - 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 dbdefault
 - 000111 -10.5 db
 - 011111 -46.5 db.....default
 - 111111 muted (instead of -94.5 db)

I/O Offset n3 – DXSn Read Channel Right VolumeRW

- 7-6 Reserved always reads 0
- 5-0 Right Volume Control
 - 000000 0 dbdefault
 - 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 Reservedalways 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 StoppedRO
- 1 SGD EOLRWC
- 0 SGD FlagRWC

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 Disabledefault
 - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
 - 0 Disabledefault
 - 1 Enable

I/O Offset 42 – 3D Channel SGD FormatRW

- 7 PCM Format
 - 0 8-bitdefault
 - 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 – ScratchRW

- 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 1st data in the sample is assigned to slot9
 - 0010 2nd data in the sample is assigned to slot9
 - 0011 3rd data in the sample is assigned to slot9
 - 0100 4th data in the sample is assigned to slot9
 - 0101 5th data in the sample is assigned to slot9
 - 0110 6th 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 StatusRWC

- 7 SGD Active (0 = completed or terminated).....RO
- 6-3 Reserved always reads 0
- 2 SGD StoppedRO
- 1 SGD EOLRWC
- 0 SGD FlagRWC

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 TypeRW

- 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 Disabledefault
 - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
 - 0 Disabledefault
 - 1 Enable

I/O Offset 57-54 – FM Channel SGD Table PointerRW

- 31-0 SGD Table Pointer Base Address (even addr).... W
- Current Pointer AddressR

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 Disabledefault
 - 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 Disabledefault
 - 1 Enable
- 0 **Interrupt on FLAG @ End-of-Blk**
 - 0 Disabledefault
 - 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

31-30	Codec ID	RW
	00 Select Primary Codec	
	01 Select Secondary Codec 01	
	10 Select Secondary Codec 10	
	11 -reserved-	
29	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 F3-F0 – SGD Status Shadow RO

31	Reserved	always reads 0
30	Write Chan 1 SGD STOP Shadow	(Rx70[2])
29	Write Chan 1 SGD EOL Shadow	(Rx70[1])
28	Write Chan 1 SGD FLAG Shadow	(Rx70[0])
27	Reserved	always reads 0
26	Write Chan 0 SGD STOP Shadow	(Rx60[2])
25	Write Chan 0 SGD EOL Shadow	(Rx60[1])
24	Write Chan 0 SGD FLAG Shadow	(Rx60[0])
23	Reserved	always reads 0
22	FM Read Chan SGD STOP Shadow	(Rx50[2])
21	FM Read Chan SGD EOL Shadow	(Rx50[1])
20	FM Read Chan SGD FLAG Shadow	(Rx50[0])
19	Reserved	always reads 0
18	3D Read Chan SGD STOP Shadow	(Rx40[2])
17	3D Read Chan SGD EOL Shadow	(Rx40[1])
16	3D Read Chan SGD FLAG Shadow	(Rx40[0])
15	Reserved	always reads 0
14	DX3 Read Chan SGD STOP Shadow	(Rx30[2])
13	DX3 Read Chan SGD EOL Shadow	(Rx30[1])
12	DX3 Read Chan SGD FLAG Shadow	(Rx30[0])
11	Reserved	always reads 0
10	DX2 Read Chan SGD STOP Shadow	(Rx20[2])
9	DX2 Read Chan SGD EOL Shadow	(Rx20[1])
8	DX2 Read Chan SGD FLAG Shadow	(Rx20[0])
7	Reserved	always reads 0
6	DX1 Read Chan SGD STOP Shadow	(Rx10[2])
5	DX1 Read Chan SGD EOL Shadow	(Rx10[1])
4	DX1 Read Chan SGD FLAG Shadow	(Rx10[0])
3	Reserved	always reads 0
2	DX0 Read Chan SGD STOP Shadow	(Rx00[2])
1	DX0 Read Chan SGD EOL Shadow	(Rx00[1])
0	DX0 Read Chan SGD FLAG Shadow	(Rx00[0])

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

I/O Offset 0 – FM NMI StatusRO

- 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 IndexRO

- 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 PausedRO
- 5-4 Reserved always reads 0
- 3 SGD Trigger Queued (transaction will restart after EOL)RO
- 2 SGD StoppedRO
- 1 SGD EOLRWC
- 0 SGD FlagRWC

I/O Offset 1 – Modem Read Channel SGD ControlRW

- 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 Disabledefault
 - 1 Enable
- 0 Interrupt on FLAG @ End-of-Blk
 - 0 Disabledefault
 - 1 Enable

I/O Offset 7-4 – Modem SGD Read Table PointerRW

- 31-0 SGD Table Pointer Base Address (even addr).... W
- Current Pointer AddressR

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 / StatusRW

- 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:

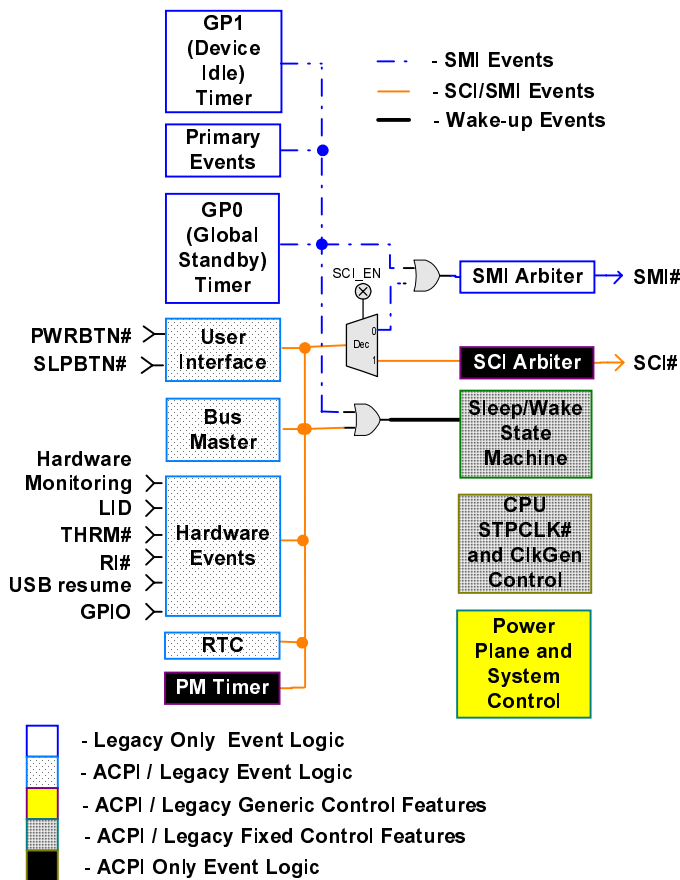


Figure 6. Power Management Subsystem Block Diagram

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:

- **I²C/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#.

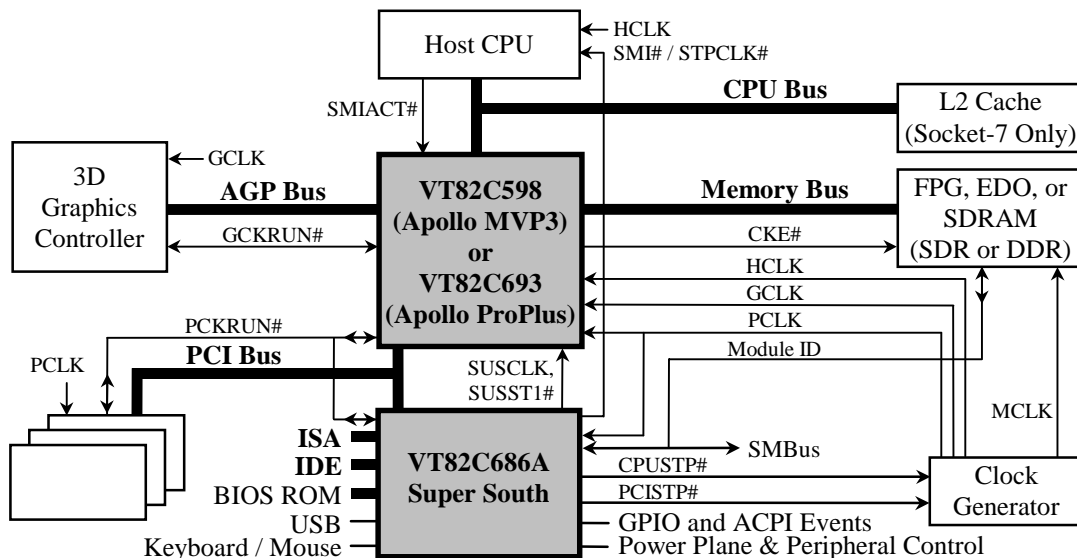


Figure 7. System Block Diagram Using the VT8231 Super South Bridge

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	Keyboard Access	I/O port 60h
6	Serial Port Access	I/O ports 3F8h-3FFh, 2F8h-2FFh, 3E8h-3EFh, or 2E8h-2EFh
5	Parallel Port Access	I/O ports 378h-37Fh or 278h-27Fh
4	Video Access	I/O ports 3B0h-3DFh or memory A/B segments
3	IDE/Floppy Access	I/O ports 1F0h-1F7h, 170h-177h, or 3F5h
2	Reserved	
1	Primary Interrupts	Each channel of the interrupt controller can be programmed to be a primary or secondary interrupt

0 ISA Master/DMA Activity

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 _S
Operating temperature - Case	0	85	°C	T _C
Operating temperature - Ambient	0	70	°C	T _A
Reference Voltage	0	5.5	Volts	V _{REF}
Core Voltage	0	3.6	Volts	V _{CC}
Suspend Voltage	-0.5	V _{CC} + 0.3	Volts	V _{SUS}
USB Voltage	-0.5	V _{CC} + 0.3	Volts	V _{USB}
Hardware Monitor Voltage	-0.5	V _{CC} + 0.3	Volts	V _{HWM}
LAN MII Voltage	-0.5	V _{CC} + 0.3	Volts	V _{MII}
LAN RAM Voltage	-0.5	V _{CC} + 0.3	Volts	V _{RAM}
PLL Voltage	-0.5	V _{CC} + 0.3	Volts	V _{PLL}
Battery Voltage	-0.5	V _{CC} + 0.3	Volts	V _{BAT}
Input voltage (3.3V only inputs)	-0.5	V _{CC} + 0.3	Volts	FERR#, USBCLK, PWRBTN#, EXTSMI#, BATLOW#, FAN1, FAN2, SMBCLK, SMBDATA
Input voltage (5V tolerant inputs)	-0.5	V _{REF} + 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_A -0-70°C, V_{REF}=5V ±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 ±0.3V

Symbol	Parameter	Min	Max	Unit	Condition
V _{IL}	Input low voltage	-0.5	0.8	V	
V _{IH}	Input high voltage	2.0	V _{CC} +0.3	V	
V _{OL}	Output low voltage	-	0.45	V	I _{OL} = 4.0mA
V _{OH}	Output high voltage	2.4	-	V	I _{OH} = -1.0mA
I _{IL}	Input leakage current	-	±10	uA	0 < V _{IN} < V _{CC}
I _{OZ}	Tristate leakage current	-	±20	uA	0.45 < V _{OUT} < V _{CC}
I _{CC}	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], SMBCK1, SMBCK2, SMBDT1, SMBDT2, SUSAN#, SUSB#, SUSC#, SUSCLK, SUSST1#, A20M#, INIT, INTR, NMI, ROMCS#, STPCLK#, CPURST, SMI#, IGNNE#, SLP#, TXD, RTS#, DTR#, IRTX	50 pF 50 pF 50 pF 50 pF 50 pF	15 ns 15 ns 15 ns 15 ns 15 ns
8 mA	KBDT, KBCK, MSDT, MSCK, PCISTP#, CPUTP#, SD[15:0], PDD[15:0], SDD[15:0], MDCK, MDIO, MTXENA, MTXD[3:0], PREQL#, PREQH#	50 pF 50 pF 50 pF 50 pF 30 pF	10 ns 8 ns 8 ns 8 ns 6 ns
12 mA	PDCS1#, PDCS3#, SDCS1#, SDCS3#, PDA[2:0], SDA[2:0], PDDACK#, SDDACK#, PDIOR#, PDIOW#, SDIOR#, SDIOW#	40 pF 40 pF	8 ns 8 ns
16 mA	LA[21:20], SA[19:0], MEMR#, MEMW#, IOR#, IOW#, PCIRST#	85 pF	10 ns
PCI	AD[31:0], CBE[3:0]#, FRAME#, DEVSEL#, IRDY#, TRDY#, STOP#, PAR, PCKRUN#	50 pF 50 pF	6 ns 5 ns
	LFRAME#, LAD[3:0], USBP[3:0] +/-		
	ACRST, ACSYNC, ACSOUT, 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#, PAR, SERIRQ, PCKRUN#
3.3V (5V Tolerant)	PGNTH#, PGNTL#, PINT[A:D]#, SA[19:0], SD[15:0], MEMR#, MEMW#, IOR#, IOW#, OSC, PDD[15:0], SDD[15:0], PDDRQ, SDDRQ, PDRDY, SDRDY, IRQ14, IRQ15, KBCK, KBDT, MSCK, MSDT, GAMED[7:0], INDEX#, TRK00#, RDATA#, DSKCHG#, WRTPR# , PD[7:0], PINIT#, STROBE#, AUTOFD#, SLCTIN#, SLCT, ACK#, ERROR#, BUSY, PE, RXD, CTS#, DSR#, DCD#, RI#, IRRX, IRRX2, SMBCK1, SMBCK2, SMBDT1, SMBDT2, SMBALRT#, MCOL, MCRS, MDIO, MRXCLK, MRXD[3:0], MRXDV, MRXERR, MTXCLK, MSI, ACSDIN[2:0], ACBITCLK, GPIOA, GPIOC, GPIOD, GPIOE, GPIO, GPI1, PWRGD, BATLOW#, THRM
3.3 V	USBP[3:0] +/-, USBCLK, USBOC[1:0]#, LDRQ#, LAD[3:0], EEDI, PCICLK, APICCLK, WSC#, FAN1, FAN2 / SLPBTN#, PWRBTN#, RTCX1, EXTSMI#, RSMRST#, PME#, LID, RING#, CPUMISS, INTRUDER#

PACKAGE MECHANICAL SPECIFICATIONS

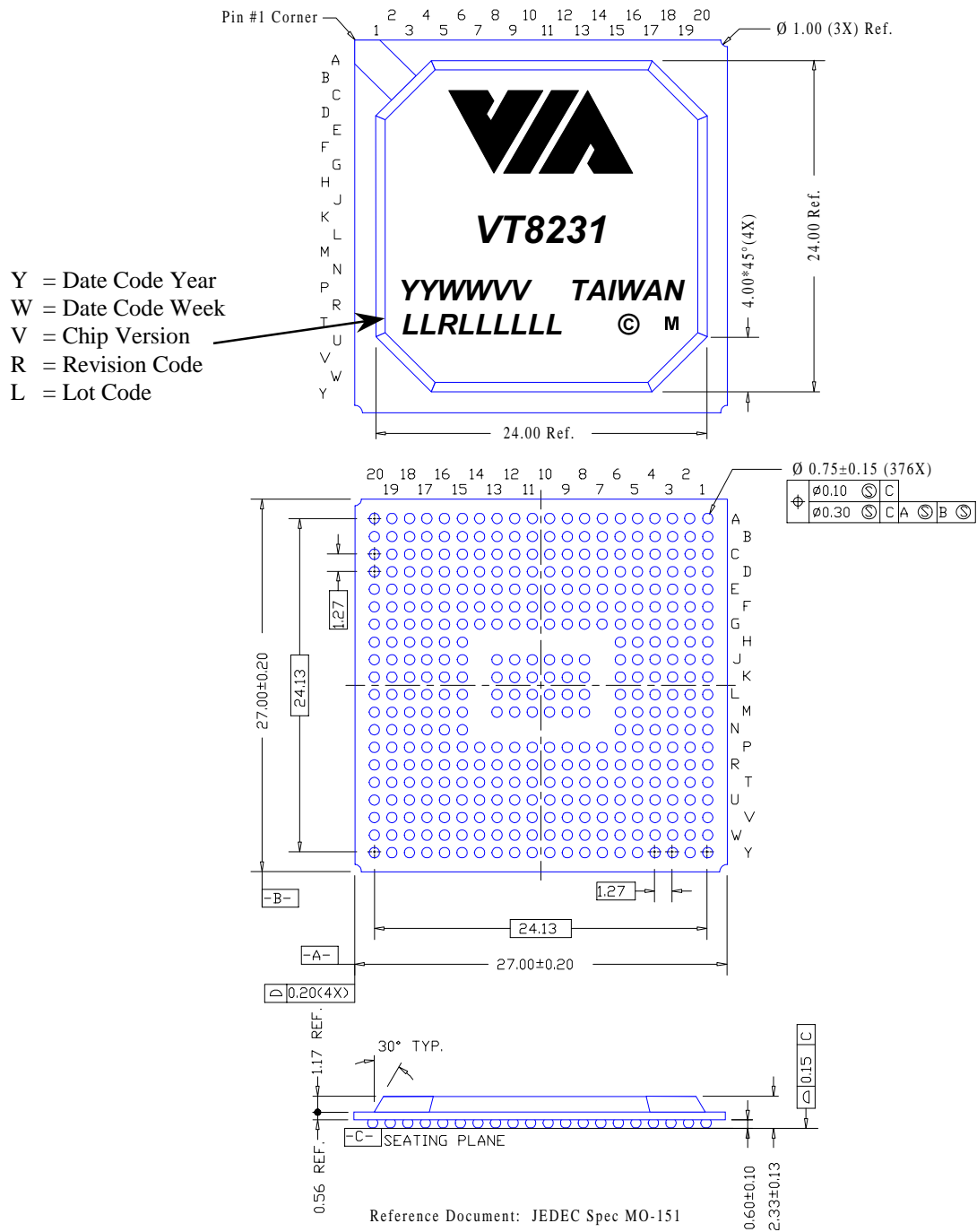


Figure 8. Mechanical Specifications – 376 Pin Ball Grid Array Package