VT82C686A
"Super South" South Bridge

PSIPC
PCI Super-I/O Integrated Peripheral Controller

PC99 COMPLIANT PCI-TO-ISA BRIDGE WITH INTEGRATED SUPER-I/O (FDC, LPT, COM1/2, AND IR), INTEGRATED SOUNDBLASTER/DIRECTSOUND AC97 AUDIO, ULTRADMA-33/66 MASTER MODE PCI-EIDE CONTROLLER, USB CONTROLLER, KEYBOARD CONTROLLER, RTC, DISTRIBUTED DMA, SERIAL IRQ, PLUG AND PLAY, ACPI, ENHANCED POWER MANAGEMENT, SMBUS, AND TEMPERATURE, VOLTAGE, AND FAN-SPEED MONITORING

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VIA TECHNOLOGIES, INC.

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Offices:

USA Office:
1045 Mission Court
Fremont, CA 94539
USA
Tel: (510) 683-3300
Fax: (510) 683-3301

Taipei Office:
8th Floor, No. 533
Chung-Cheng Road, Hsin-Tien
Taipei, Taiwan ROC
Tel: (886-2) 218-5452
Fax: (886-2) 218-5453

Online Services:

Home Page: http://www.via.com.tw –or- http://www.viatech.com
FTP Server: ftp.via.com.tw
BBS: 886-2-2185208

REVISION HISTORY

Document Release	Date	Revision	Initials
Revision 0.1	2/10/98	Initial release based on 82C596 "Mobile South" Data Sheet revision 0.3	DH
Revision 0.2	3/17/98	Updated features, overview, pins, regs; Added pin list, Sup-IO, HWM, audio	DH
Revision 0.3	4/20/98	Revised pinouts, fixed TC, changed reg defs, added regs in funcs 1, 3, & 4:	DH
Revision 0.4	4/29/98	Corrected TC, features, pin descriptions, f4/game port regs, removed timing	DH
Revision 0.5	5/27/98	Updated feature bullets, pinouts, registers in functions 0-4 and I/O	DH
Revision 0.6	5/29/98	Updated registers in functions 1, 3, and 4	DH
Revision 0.72	12/1/98	Changed name to 686A, updated feature bullets, pin names, & register defs	DH
Revision 0.8	12/7/98	Updated register definitions	DH
Revision 0.9	12/9/98	Updated register definitions	DH
Revision 1.0	1/15/99	Corrected feature bullets, pin typos, ROMCS# description, f0Rx8, f4Rx2	DH
Revision 1.1	4/15/99	Fixed block diagram, pinouts, register descriptions and electrical specs	DH
Revision 1.23	5/17/99	Fixed GPI1,5,6, GPO1-3,6, PCS0#, DRQ2/DACK2#, MCCS#, PCS0#, GPO0/SLOWCLK, GPIOA-D, DACK0-7# IRQ option, FDC on LPT Fixed SuperIO RxF0-1,F6; FDCIObase+1,Fn0Rx43,59,5B-C,68,74-7F,80,88, 88,8A-F,Fn1Rx43,45,54,Fn2&3Rx8,41,42,Fn4Rx54,D2,PMUIORx0,20, 22,24,28/2A,2C,38,40,42,44-5,HWMIORx28-29,35-38,Fn5Rx6,2C,42,48	DH
Revision 1.24	6/18/99	Changed DRVEN to DRVDEN, moved PME# from W11 to T11 MCCS# on U5, SCIOUT# on U8 for "CF" (opposite prior to "CF") Fixed F0 Rx42,74,76, F1 Rx43, F5/6 Rx48, PMU I/O Rx44	DH
Revision 1.3	6/25/99	Rev 1.3x created to document CD/CE **only** (info on version CF removed)	DH
Revision 1.4	6/25/99	Updated U5/U8 pin defs; fixed Rx74[5,7],76[4-3],77[0],PMUIO Rx44[5,3-1]	DH
Revision 1.42	7/7/99	Fixed typo in SUSST1# pin description; Fixed Super-I/O RxF8 table Modified F0 Rx59, F1 Rx6,9,34,3C,41,54,71-75,79-7D,C0-C7, F2/3 Rx41-42,80-84, F4 Rx4C[0], PMU I/O Rx4[0],20-21[1],22-23[1],24-25[1],2C-2D[3], HWM IO Rx42[2-1],44[2-1], F5/6 Rx4A-4B, IO Base 0 Rx12[6]	DH
Revision 1.43	10/7/99	Fixed typo in PDIOR#/SDIOR# pin descriptions & Func 4 Rx42[4]	DH
Revision 1.45	12/3/99	Added SCIOUT# to GPIO11 (pin U8), fixed typos in CHAS pin description Fixed typos in Serial Port 2 register descriptions, changed to new logo format	DH
Revision 1.5	12/21/99	Changed FDC "OD" pin types to "O"; fixed table 2 ECP port address range Fixed register summary tables: SuperIO Cfg E2; FDC 4, 7 Fixed reg descriptions: SuperIO Cfg E2 & EE defaults; FDCbase+4 & +7; LPTbase+402; COM1/2 index value references; Com1/2 Divisor offset	DH
Revision 1.51	1/7/00	Changed silicon version CF to CF/CG (CG same programming / pinout as CF) Fixed IR description (no 3rd serial port – muxed on COM2) Fixed Parallel Port I/O Index, FDC I/O index & Base+7 register description Fixed typo in Func 4 Rx48 description Changed Pwr Mgmt I/O Rx44[3-2] (different for CD/DE & CF/CG silicon)	DH
Revision 1.52	1/17/00	Added internal I/O APIC pin names; fixed LID name polarity in pin diagram Corrected F0 Rx41[6],58,74[7],77[4], F1 Rx54[5], F2/3 Rx43, F4 Rx4D[3],54[3-2],55[2], PMU IO Rx0[8], added APIC regs	DH
Revision 1.53	2/8/00	Fixed feature bullet typos, APIC/GPI/GPO pin descriptions, F0 Rx76[4],77[4] Fixed Func 5/6 AC97 reg summary tables; KBC Ctrl bit-3 changed to reserved	DH
Revision 1.54	2/25/00	Fixed pin direction for APICD0-1 pins (changed from O to IO) Fixed defaults in register tables for Func 1 Rx40, 41, 43, 45, 50 Added notea to F0 Rx41[3] & Rx45; fixed F1 Rx45[1-0] & misc typos	DH

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- **Inter-operable with VIA and other Host-to-PCI Bridges**
  - Combine with VT82C598 for a complete Super-7 (66/75/83/100MHz) PCI / AGP / ISA system (Apollo MVP3)
  - Combine with VT8501 for a complete Super-7 system with integrated 2D / 3D graphics (Apollo MVP4)
  - Combine with VT82C693 for a complete 66 / 100 / 133 MHz Socket-370 or Slot-1 system (Apollo Pro133)
  - Combine with VT8601 for a complete 66 / 100 / 133 MHz Socket-370 or Slot-1 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 / ISA system
- **PCI to ISA Bridge**
  - Integrated ISA Bus Controller with integrated DMA, timer, and interrupt controller
  - 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 USB Controller with root hub and four function ports
  - Integrated UltraDMA-33/66 master mode EIDE controller with enhanced PCI bus commands
  - PCI-2.2 compliant with delay transaction and remote power management
  - Eight double-word line buffer between PCI and ISA bus
  - One level of PCI to ISA post-write buffer
  - Supports type F DMA transfers
  - Distributed DMA support for ISA legacy DMA across the PCI bus
  - Serial interrupt for docking and non-docking applications
  - Fast reset and Gate A20 operation
  - Edge trigger or level sensitive interrupt
  - Flash EPROM, 4Mb EPROM and combined BIOS support
  - Supports positive and subtractive decoding

- **UltraDMA-33 / 66 Master Mode PCI EIDE Controller**
  - Dual channel master mode PCI supporting four Enhanced IDE devices
  - Transfer rate up to 33MB/sec to cover PIO mode 4, multi-word DMA mode 2 drives, and UltraDMA-33 interface
  - Increased reliability using UltraDMA-66 transfer protocols
  - Thirty-two levels (doublewords) of prefetch and write buffers
  - Dual DMA engine for concurrent dual channel operation
  - Bus master programming interface for SFF-8038i rev.1.0 and Windows-95 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
  - Infrared-IrDA (HPSIR) and ASK (Amplitude Shift Keyed) IR port multiplexed on COM2
  - Multi-mode parallel port
    Standard mode, ECP and EPP support
    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**
  - Dual full-duplex Direct Sound channels between system memory and AC97 link
  - PCI master interface with scatter / gather and bursting capability
  - 32 byte FIFO of each direct sound channel
  - Host based sample rate converter and mixer
  - Standard v1.0 or v2.0 AC97 Codec interface for single or cascaded AC97 Codec's from multiple vendors
  - Loopback capability for re-directing mixed audio streams into USB and 1394 speakers
  - Hardware SoundBlaster Pro for Windows DOS box and real-mode DOS 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
- **Voltage, Temperature, Fan Speed Monitor and Controller**
  - Five positive voltage (one internal), three temperature (one internal) and two fan-speed monitoring
  - 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)

- **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**
  - Host interface for processor communications
  - Slave interface for external SMBus masters
- **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
  - Up to 12 general purpose input ports and 23 output ports
  - 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 98™, Windows NT™, Windows 95™ and plug and play BIOS compliant
- **Integrated I/O APIC (Advanced Peripheral Interrupt Controller) (CG Silicon)**
- **Built-in NAND-tree pin scan test capability**
- **0.35um, 3.3V, low power CMOS process**
- **Single chip 27x27 mm, 352 pin BGA**

OVERVIEW

The VT82C686A PSIPC (PCI Super-I/O Integrated Peripheral Controller) is a high integration, high performance, power-efficient, and high compatibility device that supports Intel and non-Intel based processor to PCI bus bridge functionality to make a complete Microsoft PC99-compliant PCI/ISA system. In addition to complete ISA extension bus functionality, the VT82C686A 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 VT82C686A also supports the UltraDMA-33 standard to allow reliable data transfer rates up to 33MB/sec throughput. The VT82C686A also supports the UltraDMA-66 standard. The IDE controller is SFF-8038i v1.0 and Microsoft Windows-family compliant.

b) Universal Serial Bus controller that is USB v1.1 and Universal HCI v1.1 compliant. The VT82C686A 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.

c) Keyboard controller with PS2 mouse support.

d) Real Time Clock with 256 byte extended CMOS. In addition to the standard ISA RTC functionality, the integrated RTC also includes the date alarm, century field, and other enhancements for compatibility with the ACPI standard.

e) 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.

f) Hardware monitoring subsystem for managing system / motherboard voltage levels, temperatures, and fan speeds

g) Full System Management Bus (SMBus) interface.

h) Two 16550-compatible serial I/O ports with infrared communications port option on the second port.

i) 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.

j) Two game ports and one MIDI port

k) ECP/EPP-capable parallel port

l) Standard floppy disk drive interface

m) Distributed DMA capability for support of ISA legacy DMA over the PCI bus. Serial IRQ is also supported for docking and non-docking applications.

n) Plug and Play controller that allows complete steerability of all PCI interrupts and internal interrupts / DMA channels 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.

o) Internal I/O APIC (Advanced Programmable Interrupt Controller)

The VT82C686A also enhances the functionality of the standard ISA peripherals. The integrated interrupt controller supports both edge and level triggered interrupts channel by channel. The integrated DMA controller supports type F DMA in addition to standard ISA DMA modes. Compliant with the PCI-2.2 specification, the VT82C686A supports delayed transactions and remote power management so that slower ISA peripherals do not block the traffic of the PCI bus. Special circuitry is built in to allow concurrent operation without causing dead lock even in a PCI-to-PCI bridge environment. The chip also includes eight levels (doublewords) of line buffers from the PCI bus to the ISA bus to further enhance overall system performance.

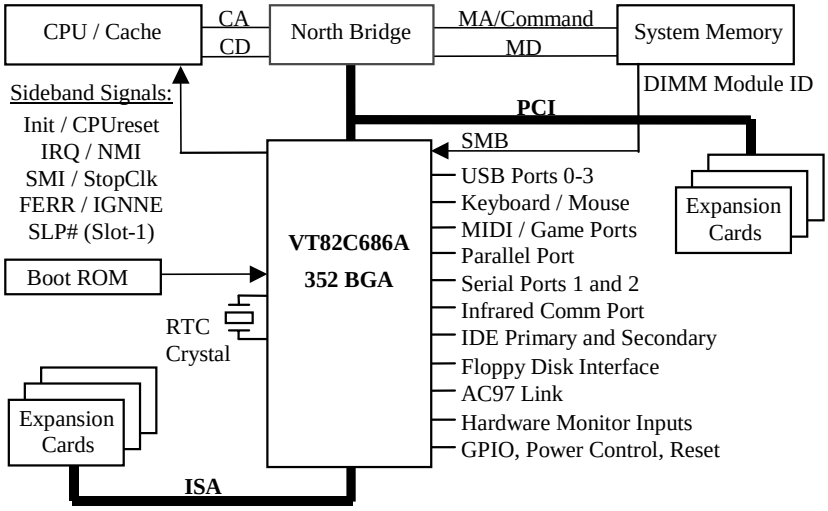

Figure 1. PC System Configuration Using the VT82C686A