



VT82C693A

Apollo Pro133

66 / 100 / 133 MHz

**Single-Chip Slot-1 / Socket-370 North Bridge
for Desktop and Mobile PC Systems
with AGP 2x and PCI**

**plus Advanced ECC Memory Controller
supporting SDRAM, VCM, EDO, and FPG DRAM**

Revision 1.0
July 22, 1999

VIA TECHNOLOGIES, INC.

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REVISION HISTORY

Document Release	Date	Revision	Initials
0.1	12/9/98	Initial internal release as VT82C694	EC
0.2	12/31/98	Changed part number to VT82C693A Fixed definition of strapping option on MAB8# Fixed pin numbers of RESET#, PREQ#, and REQ0# Updated register definitions: Device 0 Rx68[1-0], Rx69[5], Rx50[3-1], Rx53[5], Rx69[6-5,1], Rx7A[4-1], RxF8-F9, RxAD, Device 1 Rx2 (Device ID=8691), Rx4[5], Rx41[0], Rx42[0]	DH
0.21	1/6/99	Fixed minor typo in AGP feature bullets	DH
0.22	1/13/99	Fixed placement diagram in pin descriptions	DH
0.3	4/1/99	Fixed typo in pinout section footer Changed pin AC4 from SUSCLK to PCKRUN# Added DCLKRD function to pin AB22 (MAA14) Updated function 0 registers Rx50[5,3-1], 51[5,2-1], 53[5-3, 67-64[2], 69[7-5,1], 6B[5,3-1], 6C[4], 73[4], 76[7], 7A[3], AD[4], F9, FC	DH
0.4	5/26/99	Updated & fixed typos in feature bullets and intro Modified device 0 Rx6[6], 8 default, 68[1-0], 69[7-6], 70[3], 72[7], 76[5-4], A7 readback value, FC[1-0], FD[2-0] Modified device 1 Rx2-3 and added 1B and F0-F7	DH
0.5	7/13/99	Added SDRAM AC Timing Fixed AGPREF pin description	DH
0.51	7/15/99	Fixed CPURST# and CPURSTD# pin descriptions and pin directions Added Host CPU Interface AC Timing	DH
1.0	7/22/99	Product announced so "NDA Req'd" watermark removed (content unchanged)	DH

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VIA VT82C693A APOLLO PRO133

66 / 100 / 133 MHz

Single-Chip Slot-1 / Socket-370 North Bridge
for Desktop and Mobile PC Systems
with AGP 2x and PCI
plus Advanced ECC Memory Controller
supporting SDRAM, VCM, EDO, and FPG

- **AGP / PCI / ISA Mobile and Deep Green PC Ready**

- GTL+ compliant host bus supports write-combine cycles
- Supports separately powered 3.3V (5V tolerant) interface to system memory, AGP, and PCI bus
- Modular power management and clock control for mobile system applications
- Combine with VIA VT82C596B south bridge chip for state-of-the-art system power management

- **High Integration**

- Single chip implementation for 64-bit Slot-1/Socket-370 CPU, 64-bit system memory, 32-bit PCI and 32-bit AGP interfaces
- **Apollo Pro133** Chipset: **VT82C693A** system controller and **VT82C596B** PCI to ISA bridge
- Chipset includes UltraDMA-33/66 EIDE, USB, and Keyboard / PS2-Mouse Interfaces plus RTC / CMOS on chip

- **High Performance CPU Interface**

- Supports Slot-1 and Socket-370 (Intel Pentium II™, Pentium III™ and Celeron™) processors
- 66 / 100 / 133 MHz CPU Front Side Bus (FSB)
- Built-in PLL (Phase Lock Loop) circuitry for optimal skew control within and between clocking regions
- Five outstanding transactions (four In-Order Queue (IOQ) plus one input latch)
- Supports WC (Write Combining) cycles
- Dynamic deferred transaction support
- Sleep mode support
- System management interrupt, memory remap and STPCLK mechanism

• Full Featured Accelerated Graphics Port (AGP) Controller

- Synchronous and pseudo-synchronous with the host CPU bus with optimal skew control

<u>PCI</u>	<u>AGP</u>	<u>CPU</u>	<u>Mode</u>
33 MHz	66 MHz	133 MHz	4x synchronous
33 MHz	66 MHz	100 MHz	3x synchronous
33 MHz	66 MHz	66 MHz	2x synchronous

- AGP v2.0 compliant
- Supports SideBand Addressing (SBA) mode (non-multiplexed address / data)
- Supports 133MHz 2X mode for AD and SBA signaling
- Pipelined split-transaction long-burst transfers up to 533 MB/sec
- Eight level read request queue
- Four level posted-write request queue
- Thirty-two level (quadwords) read data FIFO (256 bytes)
- Sixteen level (quadwords) write data FIFO (128 bytes)
- Intelligent request reordering for maximum AGP bus utilization
- Supports Flush/Fence commands
- Graphics Address Relocation Table (GART)
 - One level TLB structure
 - Sixteen entry fully associative page table
 - LRU replacement scheme
 - Independent GART lookup control for host / AGP / PCI master accesses
- Windows 95 OSR-2 VXD and integrated Windows 98 / NT5 miniport driver support

• Concurrent PCI Bus Controller

- PCI buses are synchronous / pseudo-synchronous to host CPU bus
- 33 MHz operation on the primary PCI bus
- 66 MHz PCI operation on the AGP bus
- PCI-to-PCI bridge configuration on the 66MHz PCI bus
- Supports up to five PCI masters
- Peer concurrency
- Concurrent multiple PCI master transactions; i.e., allow PCI masters from both PCI buses active at the same time
- Zero wait state PCI master and slave burst transfer rate
- PCI to system memory data streaming up to 132Mbyte/sec
- PCI master snoop ahead and snoop filtering
- Two lines of CPU to PCI posted write buffers
- Byte merging in the write buffers to reduce the number of PCI cycles and to create further PCI bursting possibilities
- Enhanced PCI command optimization (MRL, MRM, MWI, etc.)
- Forty-eight levels (double-words) of post write buffers from PCI masters to DRAM
- Sixteen levels (double-words) of prefetch buffers from DRAM for access by PCI masters
- Delay transaction from PCI master accessing DRAM
- Read caching for PCI master reading DRAM
- Transaction timer for fair arbitration between PCI masters (granularity of two PCI clocks)
- Symmetric arbitration between Host/PCI bus for optimized system performance
- Complete steerable PCI interrupts
- PCI-2.2 compliant, 32 bit 3.3V PCI interface with 5V tolerant inputs

- **Advanced High-Performance DRAM Controller**

- DRAM interface synchronous with host CPU (66/100/133 MHz) or AGP (66MHz) for most flexible configuration
- DRAM interface may be faster than CPU by 33 MHz to allow use of PC100 with 66 MHz Celeron or use of PC133 with 100 MHz Pentium II or Pentium III
- DRAM interface may be slower than CPU by 33 MHz to allow use of older memory modules with a new CPU
- Concurrent CPU, AGP, and PCI access
- Supports FP, EDO, SDRAM and VCM SDRAM memory types
- Different DRAM types may be used in mixed combinations
- Different DRAM timing for each bank
- Dynamic Clock Enable (CKE) control for SDRAM power reduction in high speed systems
- Mixed 1M / 2M / 4M / 8M / 16M / 32MxN DRAMs
- 8 banks up to 1.5 GB DRAMs (256Mb DRAM technology)
- Flexible row and column addresses
- 64-bit data width only
- 3.3V DRAM interface with 5V-tolerant inputs
- Programmable I/O drive capability for MA, command, and MD signals
- Dual copies of MA signals for improved drive
- Optional bank-by-bank ECC (single-bit error correction and multi-bit error detection) or EC (error checking only) for DRAM integrity
- Two-bank interleaving for 16Mbit SDRAM support
- Two-bank and four bank interleaving for 64Mbit SDRAM support
- Supports maximum 8-bank interleave (i.e., 8 pages open simultaneously); banks are allocated based on LRU
- Independent SDRAM control for each bank
- Seamless DRAM command scheduling for maximum DRAM bus utilization (e.g., precharge other banks while accessing the current bank)
- Four cache lines (16 quadwords) of CPU to DRAM write buffers
- Four cache lines of CPU to DRAM read prefetch buffers
- Read around write capability for non-stalled CPU read
- Speculative DRAM read before snoop result
- Burst read and write operation
- x-2-2-2-2-2-2 back-to-back accesses for EDO DRAM from CPU or from DRAM controller
- x-1-1-1-1-1-1 back-to-back accesses for SDRAM
- BIOS shadow at 16KB increment
- Decoupled and burst DRAM refresh with staggered RAS timing
- CAS before RAS or self refresh

- **Advanced System Power Management Support**

- Dynamic power down of SDRAM (CKE)
- Independent clock stop controls for CPU / SDRAM, AGP, and PCI bus
- PCI and AGP bus clock run and clock generator control
- VTT suspend power plane preserves memory data
- Suspend-to-DRAM and Self-Refresh operation
- EDO self-refresh and SDRAM self-refresh power down
- 8 bytes of BIOS scratch registers
- Low-leakage I/O pads

- **Built-in NAND-tree pin scan test capability**

- **3.3V, 0.35um, high speed / low power CMOS process**

- **35 x 35 mm, 492 pin BGA Package**

OVERVIEW

The **Apollo Pro133** is a high performance, cost-effective and energy efficient chip set for the implementation of AGP / PCI / ISA desktop personal computer systems from 66 MHz, 100 MHz and 133 MHz based on 64-bit Socket-370 and Slot-1 (Intel Pentium-II, Pentium III, and Celeron) super-scalar processors.

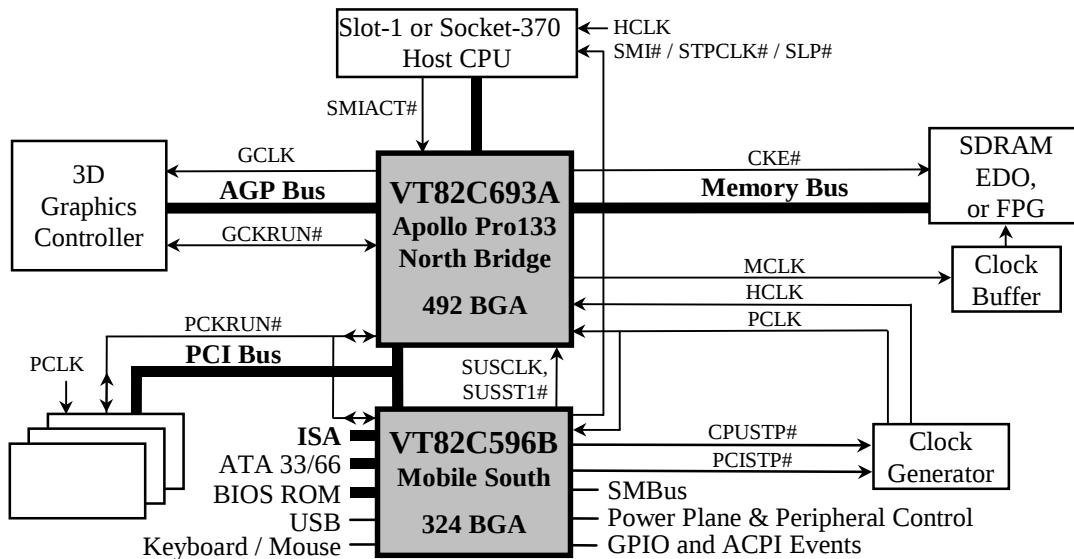


Figure 1. Apollo Pro133 System Block Diagram Using the VT82C596B Mobile South Bridge

The Apollo Pro133 chip set consists of the VT82C693A system controller (492 pin BGA) and the VT82C596B PCI to ISA bridge (324 pin BGA). The system controller provides superior performance between the CPU, DRAM, AGP bus, and PCI bus with pipelined, burst, and concurrent operation.

The VT82C693A supports eight banks of DRAMs up to 1.5GB. The DRAM controller supports standard Fast Page Mode (FPM) DRAM, EDO-DRAM, Synchronous DRAM (SDRAM) and Virtual Channel SDRAM (VC SDRAM), in a flexible mix / match manner. The Synchronous DRAM interface allows zero wait state bursting between the DRAM and the data buffers at 66/100/133 MHz. The eight banks of DRAM can be composed of an arbitrary mixture of 1M / 2M / 4M / 8M / 16M / 32MxN DRAMs. The DRAM controller also supports optional ECC (single-bit error correction and multi-bit detection) or EC (error checking) capability separately selectable on a bank-by-bank basis. The DRAM controller can run at either the host CPU bus frequency (66 / 100 / 133 MHz) or at the AGP bus frequency (66 MHz) with built-in PLL timing control.

The VT82C693A system controller also supports full AGP v2.0 capability for maximum bus utilization including 2x mode transfers, SBA (SideBand Addressing), Flush/Fence commands, and pipelined grants. An eight level request queue plus a four level post-write request queue with thirty-two and sixteen quadwords of read and write data FIFO's respectively are included for deep pipelined and split AGP transactions. A single-level GART TLB with 16 full associative entries and flexible CPU / AGP / PCI remapping control is also provided for operation under protected mode operating environments. Both Windows-95 VXD and Windows-98 / NT5 miniport drivers are supported for interoperability with major AGP-based 3D and DVD-capable multimedia accelerators.

The VT82C693A supports two 32-bit 3.3 / 5V system buses (one AGP and one PCI) that are synchronous / pseudo-synchronous to the CPU bus. The chip also contains a built-in bus-to-bus bridge to allow simultaneous concurrent operations on each bus. Five levels (doublewords) of post write buffers are included to allow for concurrent CPU and PCI operation. For PCI master operation, forty-eight levels (doublewords) of post write buffers and sixteen levels (doublewords) of prefetch buffers are included for concurrent PCI bus and DRAM/cache accesses. The chip also supports enhanced PCI bus commands such as Memory-Read-Line, Memory-Read-Multiple and Memory-Write-Invalid commands to minimize snoop overhead. In addition, advanced features are supported such as snoop ahead, snoop filtering, L1 write-back forward to PCI master, and L1 write-back merged with PCI post

write buffers to minimize PCI master read latency and DRAM utilization. Delay transaction and read caching mechanisms are also implemented for further improvement of overall system performance.

The 324-pin Ball Grid Array VT82C596B PCI to ISA bridge supports four levels (doublewords) of line buffers, type F DMA transfers and delay transaction to allow efficient PCI bus utilization and (PCI-2.2 compliant). The VT82C596B also includes an integrated keyboard controller with PS2 mouse support, integrated DS12885 style real time clock with extended 256 byte CMOS RAM, integrated master mode enhanced IDE controller with full scatter / gather capability and extension to UltraDMA-33/66 for 33/66 MB/sec transfer rate, integrated USB interface with root hub and two function ports with built-in physical layer transceivers, Distributed DMA support, and OnNow / ACPI compliant advanced configuration and power management interface.

For sophisticated power management, the Apollo Pro133 provides independent clock stop control for the CPU / SDRAM, PCI, and AGP buses and Dynamic CKE control for powering down of the SDRAM. A separate suspend-well plane is implemented for the SDRAM control signals for Suspend-to-DRAM operation. Coupled with the VT82C596B south bridge chip, a complete power conscious PC main board can be implemented with no external TTLs.

The Apollo Pro133 chipset is ideal for high performance, high quality, high energy efficient and high integration desktop and notebook AGP / PCI / ISA computer systems.

PINOUTS

Figure 2. VT82C693A 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	21	22	23	24	25	26														
A	GND	AD20	REQ0#	AD25	AD29	RESET#	HD56#	HD62#	HD55#	HD54#	HD49#	HD47#	HD40#	GND	HD33#	HD31#	HD27#	HD19#	HD20#	HD10#	HD6#	HD3#	HA29#	HA24#	HA22#	GND														
B	VCC	PCLK	AD22	AD27	AD28	PREQ#	HD50#	HD61#	HD63#	HD53#	HD48#	HD42#	HD36#	HD43#	HD32#	HD29#	HD25#	HD21#	HD18#	HD12#	HD8#	HD0#	CPU RST#	HA27#	HA20#	BREQ 0#														
C	AD19	PCIREF	AD21	CBE3#	GND	AD31	REQ1#	HD52#	GND	HD60#	HD59#	HD51#	HD44#	HD37#	HD28#	HD26#	HD22#	GND	HD17#	HD7#	HD5#	GND	HA26#	HA28#	HA23#	HA21#														
D	AD16	AD18	AD17	AD23	AD26	PGNT#	GNT1#	REQ3#	HD58#	REQ4#	HD46#	HD41#	HD39#	HD34#	HD35#	HD30#	HD24#	HD16#	HD15#	HD14#	HD4#	HD1#	HA31#	HA25#	HA18#	HA19#														
E	FRM#	IRDY#	GND	CBE2#	AD24	AD30	GNT0#	GNT3#	GNT4#	GNT2#	HD57#	GND	HD45#	HD38#	GND	GTL REF	HD23#	HD13#	HD11#	HD9#	HD2#	HA30#	HA15#	GND	HA17#	HA16#														
F	SERR#	LOCK#	DEV SEL#	STOP#	TRDY#	GND	VCC	GND	VCC	REQ2#	11	12	13	14	15	16	VTT	VCC	GND	VCC	GND	HA11#	HA12#	HA13#	HA14#	HA8#														
G	AD13	AD14	CBE1#	AD15	PAR	VCC	G7	8	9	10											17	18	19	G20	VCC	HA10#	HA5#	HA7#	HA3#	HA9#										
H	AD8	AD7	AD10	AD12	AD11	GND	H	9																						H	GND	HA4#	HA6#	BNR#	H TRDY#	BPRI#				
J	AD5	AD6	GND	CBE0#	AD9	VCC	J	PCI Pins																						J	VCC	HREQ 0#	HREQ 1#	GND	HREQ 4#	DEFER#				
K	SBA0	AD1	AD3	AD2	AD4	AD0	K	Pins		K10	11	12	13	14	15	16	K17	Pins		K	ADS#	HLOCK#	DRDY#	HREQ 2#	HREQ 3#	RS0#														
L	ST2	ST1	GGNT#	ST0	GREQ#	L											L	VCC	GND	VCC	VCC	GND	VCC	L											L	HITM#	DBSY#	HIT#	RS2#	RS1#
M	SBA2	SBA1	GPIPE#	GRBF#	GND	M											M	GND	VCC	GND	GND	VCC	GND	M											M	GND	GTL REF	VTT	TEST IN#	CPU RSTD#
N	GND	SBA3	SBS#	AGP REF	GCLK	N											N	VCC	GND	GND	GND	GND	VCC	N											N	VCCA	HCLK	GND	MD63	VCC
P	VCC	SBA4	SBA6	SBA5	GCLK0	P											P	VCC	GND	GND	GND	GND	VCC	P											P	NC	MD62	MD30	MD31	GND
R	SBA7	GD31	GD29	GD30	GND	R											R	GND	VCC	GND	GND	VCC	GND	R											R	GND	MD28	MD60	MD61	MD29
T	GD27	GD26	GD24	GD25	GDS1#	T											T	VCC	GND	VCC	VCC	GND	VCC	T											T	MD57	MD58	MD25	MD26	MD59
U	GD23	GBE3#	GD22	GD21	GD19	GD28	U	AGP Pins		U10	11	12	13	14	15	16	U17	DRAM Pins		U	MD27	MD22	MD56	MD55	MD23	MD24														
V	GD20	GD17	GND	GBE2#	G IRDY#	VCC	V	Pins																						V	VCC	MD19	MD20	GND	MD21	MD54				
W	GD16	GD18	GFRM#	G TRDY#	GDEV SEL#	GND	W																					W	GND	MD18	MD50	MD51	MD53	MD52						
Y	G STOP#	GPAR	GD15	GBE1#	GD14	VCCA	Y7	8	9	10											17	18	19	Y20	VCCA	MECC3	MD16	MD48	MD49	MD17										
AA	GD13	GD12	GD10	GD11	GD9	GND	VCC	GND	VCC	MECC5	11	12	13	14	15	16	SRAS B#	VCC	GND	VCC	GND	CAS A2#	MECC6	CAS A3#	MECC2	MECC7														
AB	GD8	GBE0#	GND	GD7	GD0	MD2	MD37	MD40	MD41	MD44	MD14	GND	SCAS B#	RAS A0#	GND	MA A1	MA B3#	MA B6#	MA B7#	MA B10	DCLK O	MA A14	RAS B5#	GND	GND	CAS A7#														
AC	GD6	GDS0#	GD5	PCK RUN#	MD0	MD3	MD38	MD7	MD42	MD45	MD15	SWEB#	CAS A5#	CAS A1#	RAS A3#	MA B1#	MA A3	MA A7	MA A8	MA B9#	MA A12	CKE0#	CKE4#	RAS B3#	CAS A6#	RAS B4#														
AD	GD4	GD3	GD2	SU STAT#	GND	MD35	MD5	MD8	GND	MD12	MD47	MECC1	CAS A4#	CAS B1#	RAS A4#	MA B0#	MA A2	GND	MA B5#	MA A10	MA B12#	GND	CKE3#	RAS B1#	DCLK WR	RAS B2#														
AE	VCC	GD1	WSC#	MD33	MD1	MD36	MD6	MD10	MD43	MD13	MECC4	SWEA#	CAS B5#	CAS A0#	RAS A2#	RAS A5#	MA A2	MA B4#	MA A5	MA A9	MA B11#	NC	NC	CKE2#	RAS B0#	VCC														
AF	GND	VCC	PWR OK	MD32	MD34	MD4	MD39	MD9	MD11	MD46	MECC0	SCAS A#	GND	VCC	RAS A1#	SRAS A#	MA A0	MA A4	MA A6	MA B8#	MA A11	MA B13#	CKE1#	CKE5#	MA A13	GND														

Figure 3. VT82C693A Pin List (Numerical Order)

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
A01	P GND	D05	IO AD26	H03	IO AD10	P01	P VCC	W25	IO MD53	AC23	O CKE4#
A02	IO AD20	D06	O PGNT#	H04	IO AD12	P02	I SBA4	W26	IO MD52	AC24	O RASB3# / CSB3#
A03	I REQ0#	D07	O GNT1#	H05	IO AD11	P03	I SBA6	Y01	IO GSTOP#	AC25	O CASA6# / DOM6#
A04	IO AD25	D08	I REQ3#	H06	P GND	P04	I SBA5	Y02	IO GPAR	AC26	O RASB4# / CSB4#
A05	IO AD29	D09	IO HD58#	H21	P GND	P05	O GCLKO	Y03	IO GD15	AD01	IO GD04
A06	I RESET#	D10	I REQ4#	H22	IO HA04#	P11	P VCC	Y04	IO GBE1#	AD02	IO GD03
A07	IO HD56#	D11	IO HD46#	H23	IO HA06#	P12	P GND	Y05	IO GD14	AD03	IO GD02
A08	IO HD62#	D12	IO HD41#	H24	IO BNR#	P13	P GND	Y06	P VCCA	AD04	I SUSTAT#
A09	IO HD55#	D13	IO HD39#	H25	IO HTRDY#	P14	P GND	Y21	P VCCA	AD05	P GND
A10	IO HD54#	D14	IO HD34#	H26	IO BPRI#	P15	P GND	Y22	IO MECC3	AD06	IO MD35
A11	IO HD49#	D15	IO HD35#	J01	IO AD05	P16	P VCC	Y23	IO MD16	AD07	IO MD05
A12	IO HD47#	D16	IO HD30#	J02	IO AD06	P22	- NC	Y24	IO MD48	AD08	IO MD08
A13	IO HD40#	D17	IO HD24#	J03	P GND	P23	IO MD62	Y25	IO MD49	AD09	P GND
A14	P GND	D18	IO HD16#	J04	IO CBE0#	P24	IO MD30	Y26	IO MD17	AD10	IO MD12
A15	IO HD33#	D19	IO HD15#	J05	IO AD09	P25	IO MD31	AA01	IO GD13	AD11	IO MD47
A16	IO HD31#	D20	IO HD14#	J06	P VCC	P26	P GND	AA02	IO GD12	AD12	IO MECC1
A17	IO HD27#	D21	IO HD04#	J21	P VCC	R01	I SBA7	AA03	IO GD10	AD13	O CASA4# / DOM4#
A18	IO HD19#	D22	IO HD01#	J22	IO HREQ0#	R02	IO GD31	AA04	IO GD11	AD14	O CASB1#
A19	IO HD20#	D23	IO HA31#	J23	IO HREQ1#	R03	IO GD29	AA05	IO GD09	AD15	O RASA4# / CSA4#
A20	IO HD10#	D24	IO HA25#	J24	P GND	R04	IO GD30	AA06	P GND	AD16	O MAB0#
A21	IO HD06#	D25	IO HA18#	J25	IO HREQ4#	R05	P GND	AA07	P VCC	AD17	O MAB2#
A22	IO HD03#	D26	IO HA19#	J26	IO DEFER#	R11	P GND	AA08	P GND	AD18	P GND
A23	IO HA29#	E01	IO FRAME#	K01	I SBA0	R12	P VCC	AA09	P VCC	AD19	O MAB5#
A24	IO HA24#	E02	IO IRDY#	K02	IO AD01	R13	P GND	AA10	IO MECC5	AD20	O MAA10
A25	IO HA22#	E03	P GND	K03	IO AD03	R14	P GND	AA17	O SRASB#	AD21	O MAB12# / strap
A26	P GND	E04	IO CBE2#	K04	IO AD02	R15	P VCC	AA18	P VCC	AD22	P GND
B01	P VCC	E05	IO AD24	K05	IO AD04	R16	P GND	AA19	P GND	AD23	O CKE3#
B02	I PCLK	E06	IO AD30	K06	IO AD00	R22	P GND	AA20	P VCC	AD24	O RASB1# / CSB1#
B03	IO AD22	E07	O GNT0#	K21	IO ADS#	R23	IO MD28	AA21	P GND	AD25	I DCLKWR
B04	IO AD27	E08	O GNT3#	K22	I HLOCK#	R24	IO MD60	AA22	O CASA2# / DQM2#	AD26	O RASB2# / CSB2#
B05	IO AD28	E09	O GNT4#	K23	IO DRDY#	R25	IO MD61	AA23	IO MECC6	AE01	P VCC
B06	I PREQ#	E10	O GNT2#	K24	IO HREQ2#	R26	IO MD29	AA24	O CASA3# / DQM3#	AE02	IO GD01
B07	IO HD50#	E11	IO HD57#	K25	IO HREQ3#	T01	IO GD27	AA25	IO MECC2	AE03	O WSC#
B08	IO HD61#	E12	P GND	K26	IO RS0#	T02	IO GD26	AA26	IO MECC7	AE04	IO MD33
B09	IO HD63#	E13	IO HD45#	L01	O ST2	T03	IO GD24	AB01	IO GD08	AE05	IO MD01
B10	IO HD53#	E14	IO HD38#	L02	O ST1	T04	IO GD25	AB02	IO GBE0#	AE06	IO MD36
B11	IO HD48#	E15	P GND	L03	O GGNT#	T05	IO GDS1#	AB03	P GND	AE07	IO MD06
B12	IO HD42#	E16	I GTLREF	L04	O ST0	T11	P VCC	AB04	IO GD07	AE08	IO MD10
B13	IO HD36#	E17	IO HD23#	L05	I GREQ#	T12	P GND	AB05	IO GD00	AE09	IO MD43
B14	IO HD43#	E18	IO HD13#	L11	P VCC	T13	P VCC	AB06	IO MD02	AE10	IO MD13
B15	IO HD32#	E19	IO HD11#	L12	P GND	T14	P VCC	AB07	IO MD37	AE11	IO MECC4
B16	IO HD29#	E20	IO HD09#	L13	P VCC	T15	P GND	AB08	IO MD40	AE12	O SWEA# / MWEA#
B17	IO HD25#	E21	IO HD02#	L14	P VCC	T16	P VCC	AB09	IO MD41	AE13	O CASB5#
B18	IO HD21#	E22	IO HA30#	L15	P GND	T22	IO MD57	AB10	IO MD44	AE14	O CASA0# / DQM0#
B19	IO HD18#	E23	IO HA15#	L16	P VCC	T23	IO MD58	AB11	IO MD14	AE15	O RASA2# / CSA2#
B20	IO HD12#	E24	P GND	L22	I HITM#	T24	IO MD25	AB12	P GND	AE16	O RASA5# / CSA5#
B21	IO HD08#	E25	IO HA17#	L23	IO DBSY#	T25	IO MD26	AB13	O SCASB#	AE17	O MAA2
B22	IO HD00#	E26	IO HA16#	L24	IO HIT#	T26	IO MD59	AB14	O RASA0# / CSA0#	AE18	O MAB4#
B23	O CPURST#	F01	IO SERR#	L25	IO RS2#	U01	IO GD23	AB15	P GND	AE19	O MAA5
B24	IO HA27#	F02	IO LOCK#	L26	IO RS1#	U02	IO GBE3#	AB16	O MAA1	AE20	O MAA9
B25	IO HA20#	F03	IO DEVSEL#	M01	I SBA2	U03	IO GD22	AB17	O MAB3#	AE21	O MAB11# / strap
B26	O BREQ0#	F04	IO STOP#	M02	I SBA1	U04	IO GD21	AB18	O MAB6# / strap	AE22	- NC
C01	IO AD19	F05	IO TRDY#	M03	I GPIPE#	U05	IO GD19	AB19	O MAB7# / strap	AE23	- NC
C02	P PCIREF	F06	P GND	M04	I GRBF#	U06	IO GD28	AB20	O MAB10 / strap	AE24	O CKE2#
C03	IO AD21	F07	P VCC	M05	P GND	U21	IO MD27	AB21	O DCLKO	AE25	O RASB0# / CSB0#
C04	IO CBE3#	F08	P GND	M11	P GND	U22	IO MD22	AB22	O MAA14 / DCLKRD	AE26	P VCC
C05	P GND	F09	P VCC	M12	P VCC	U23	IO MD56	AB23	O RASB5# / CSB5#	AF01	P GND
C06	IO AD31	F10	I REQ2#	M13	P GND	U24	IO MD55	AB24	P GND	AF02	P VCC
C07	I REQ1#	F17	P VTT	M14	P GND	U25	IO MD23	AB25	P GND	AF03	PWROK
C08	IO HD52#	F18	P VCC	M15	P VCC	U26	IO MD24	AB26	O CASA7# / DQM7#	AF04	IO MD32
C09	P GND	F19	P GND	M16	P GND	V01	IO GD20	AC01	IO GD06	AF05	IO MD34
C10	IO HD60#	F20	P VCC	M22	P GNDA	V02	IO GD17	AC02	IO GDS0#	AF06	IO MD04
C11	IO HD59#	F21	P GND	M23	I GTLREF	V03	P GND	AC03	IO GD05	AF07	IO MD39
C12	IO HD51#	F22	IO HA11#	M24	P VTT	V04	IO GBE2#	AC04	O PCKRUN#	AF08	IO MD09
C13	IO HD44#	F23	IO HA12#	M25	I TESTIN#	V05	IO GIRDY#	AC05	IO MD00	AF09	IO MD11
C14	IO HD37#	F24	IO HA13#	M26	O CPURSTD#	V06	P VCC	AC06	IO MD03	AF10	IO MD46
C15	IO HD28#	F25	IO HA14#	N01	P GND	V21	P VCC	AC07	IO MD38	AF11	IO MECC0
C16	IO HD26#	F26	IO HA08#	N02	I SBA3	V22	IO MD19	AC08	IO MD07	AF12	O SCASA#
C17	IO HD22#	G01	IO AD13	N03	I SBS#	V23	IO MD20	AC09	IO MD42	AF13	P GND
C18	P GND	G02	IO AD14	N04	P AGPREF	V24	P GND	AC10	IO MD45	AF14	P VCC
C19	IO HD17#	G03	IO CBE1#	N05	I GCLK	V25	IO MD21	AC11	IO MD15	AF15	O RASA1# / CSA1#
C20	IO HD07#	G04	IO AD15	N11	P VCC	V26	IO MD54	AC12	O SWEB# / MWEB#	AF16	O SRASA#
C21	IO HD05#	G05	IO PAR	N12	P GND	W01	IO GD16	AC13	O CASA5# / DOM5#	AF17	O MAA0
C22	P GND	G06	P VCC	N13	P GND	W02	IO GD18	AC14	O CASA1# / DQM1#	AF18	O MAA4
C23	IO HA26#	G21	P VCC	N14	P GND	W03	IO GFRM#	AC15	O RASA3# / CSA3#	AF19	O MAA6
C24	IO HA28#	G22	IO HA10#	N15	P GND	W04	IO GTRDY#	AC16	O MAB1#	AF20	O MAB8# / strap
C25	IO HA23#	G23	IO HA05#	N16	P VCC	W05	IO GDSEL#	AC17	O MAA3	AF21	O MAA11
C26	IO HA21#	G24	IO HA07#	N22	P VCCA	W06	P GNDA	AC18	O MAA7	AF22	O MAB13#
D01	IO AD16	G25	IO HA03#	N23	I HCLK	W21	P GNDA	AC19	O MAA8	AF23	O CKE1#
D02	IO AD18	G26	IO HA09#	N24	P GND	W22	IO MD18	AC20	O MAB9# / strap	AF24	O CKE5#
D03	IO AD17	H01	IO AD08	N25	IO MD63	W23	IO MD50	AC21	O MAA12	AF25	O MAA13
D04	IO AD23	H02	IO AD07	N26	P VCC	W24	IO MD51	AC22	O CKE0#	AF26	P GND

Figure 4. VT82C693A Pin List (Alphabetical Order)

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
K06	IO AD00	AA03	IO GD10	AB24	P GND	A17	IO HD27#	AD07	IO MD05	AE16	O RASA5# / CSA5#
K02	IO AD01	AA04	IO GD11	AB25	P GND	C15	IO HD28#	AE07	IO MD06	AE25	O RASB0# / CSB0#
K04	IO AD02	AA02	IO GD12	AD05	P GND	B16	IO HD29#	AC08	IO MD07	AD24	O RASB1# / CSB1#
K03	IO AD03	AA01	IO GD13	AD09	P GND	D16	IO HD30#	AD08	IO MD08	AD26	O RASB2# / CSB2#
K05	IO AD04	Y05	IO GD14	AD18	P GND	A16	IO HD31#	AF08	IO MD09	AC24	O RASB3# / CSB3#
J01	IO AD05	Y03	IO GD15	AD22	P GND	B15	IO HD32#	AE08	IO MD10	AC26	O RASB4# / CSB4#
J02	IO AD06	W01	IO GD16	AF01	P GND	A15	IO HD33#	AF09	IO MD11	AB23	O RASB5# / CSB5#
H02	IO AD07	V02	IO GD17	AF13	P GND	D14	IO HD34#	AD10	IO MD12	A03	I REQ0#
H01	IO AD08	W02	IO GD18	AF26	P GND	D15	IO HD35#	AE10	IO MD13	C07	I REQ1#
J05	IO AD09	U05	IO GD19	M22	P GNDA	B13	IO HD36#	AB11	IO MD14	F10	I REQ2#
H03	IO AD10	V01	IO GD20	W06	P GNDA	C14	IO HD37#	AC11	IO MD15	D08	I REQ3#
H05	IO AD11	U04	IO GD21	W21	P GNDA	E14	IO HD38#	Y23	IO MD16	D10	I REQ4#
H04	IO AD12	U03	IO GD22	E07	O GNT0#	D13	IO HD39#	Y26	IO MD17	A06	I RESET#
G01	IO AD13	U01	IO GD23	D07	O GNT1#	A13	IO HD40#	W22	IO MD18	K26	IO RS0#
G02	IO AD14	T03	IO GD24	E10	O GNT2#	D12	IO HD41#	V22	IO MD19	L26	IO RS1#
G04	IO AD15	T04	IO GD25	E08	O GNT3#	B12	IO HD42#	V23	IO MD20	L25	IO RS2#
D01	IO AD16	T02	IO GD26	E09	O GNT4#	B14	IO HD43#	V25	IO MD21	K01	I SBA0
D03	IO AD17	T01	IO GD27	Y02	IO GPAR	C13	IO HD44#	U22	IO MD22	M02	I SBA1
D02	IO AD18	U06	IO GD28	M03	I GPIPE#	E13	IO HD45#	U25	IO MD23	M01	I SBA2
C01	IO AD19	R03	IO GD29	M04	I GRBF#	D11	IO HD46#	U26	IO MD24	N02	I SBA3
A02	IO AD20	R04	IO GD30	L05	I GREQ#	A12	IO HD47#	T24	IO MD25	P02	I SBA4
C03	IO AD21	R02	IO GD31	Y01	IO GSTOP#	B11	IO HD48#	T25	IO MD26	P04	I SBA5
B03	IO AD22	AC02	IO GDS0#	M23	I GTLREF	A11	IO HD49#	U21	IO MD27	P03	I SBA6
D04	IO AD23	T05	IO GDS1#	E16	I GTLREF	B07	IO HD50#	R23	IO MD28	R01	I SBA7
E05	IO AD24	W05	IO GDSL#	W04	IO GTRDY#	C12	IO HD51#	R26	IO MD29	N03	I SBS#
A04	IO AD25	W03	IO GFRM#	G25	IO HA03#	C08	IO HD52#	P24	IO MD30	AF12	O SCASA#
D05	IO AD26	L03	IO GGNT#	H22	IO HA04#	B10	IO HD53#	P25	IO MD31	AB13	O SCASB#
B04	IO AD27	V05	IO GIRDY#	G23	IO HA05#	A10	IO HD54#	AF04	IO MD32	F01	IO SERR#
B05	IO AD28	A01	P GND	H23	IO HA06#	A09	IO HD55#	AE04	IO MD33	AF16	O SRASA#
A05	IO AD29	A14	P GND	G24	IO HA07#	A07	IO HD56#	AF05	IO MD34	AA17	O SRASB#
E06	IO AD30	A26	P GND	F26	IO HA08#	E11	IO HD57#	AD06	IO MD35	L04	O ST0
C06	IO AD31	C05	P GND	G26	IO HA09#	D09	IO HD58#	AE06	IO MD36	L02	O ST1
K21	IO ADS#	C09	P GND	G22	IO HA10#	C11	IO HD59#	AB07	IO MD37	L01	O ST2
N04	P AGPREF	C18	P GND	F22	IO HA11#	C10	IO HD60#	AC07	IO MD38	F04	IO STOP#
H24	IO BNR#	C22	P GND	F23	IO HA12#	B08	IO HD61#	AF07	IO MD39	AD04	I SUSTAT#
H26	IO BPRI#	E03	P GND	F24	IO HA13#	A08	IO HD62#	AB08	IO MD40	AE12	O SWEA# / MWEA#
B26	O BREQ0#	E12	P GND	F25	IO HA14#	B09	IO HD63#	AB09	IO MD41	AC12	O SWEB# / MWEB#
AE14	O CASA0# / DQM0#	E15	P GND	E23	IO HA15#	L24	IO HIT#	AC09	IO MD42	M25	I TESTIN#
AC14	O CASA1# / DQM1#	E24	P GND	E26	IO HA16#	L22	I HITM#	AE09	IO MD43	F05	IO TRDY#
AA22	O CASA2# / DQM2#	F06	P GND	E25	IO HA17#	K22	I HLOCK#	AB10	IO MD44	B01	P VCC
AA24	O CASA3# / DQM3#	F08	P GND	D25	IO HA18#	J22	IO HREQ0#	AC10	IO MD45	F07	P VCC
AD13	O CASA4# / DQM4#	F19	P GND	D26	IO HA19#	J23	IO HREQ1#	AF10	IO MD46	F09	P VCC
AC13	O CASA5# / DQM5#	F21	P GND	B25	IO HA20#	K24	IO HREQ2#	AD11	IO MD47	F18	P VCC
AC25	O CASA6# / DQM6#	H06	P GND	C26	IO HA21#	K25	IO HREQ3#	Y24	IO MD48	F20	P VCC
AB26	O CASA7# / DQM7#	H21	P GND	A25	IO HA22#	J25	IO HREQ4#	Y25	IO MD49	G06	P VCC
AD14	O CASB1#	J03	P GND	C25	IO HA23#	H25	IO HTRDY#	W23	IO MD50	G21	P VCC
AE13	O CASB5#	J24	P GND	A24	IO HA24#	E02	IO IRDY#	W24	IO MD51	J06	P VCC
J04	IO CBE0#	L12	P GND	D24	IO HA25#	F02	IO LOCK#	W26	IO MD52	J21	P VCC
G03	IO CBE1#	L15	P GND	C23	IO HA26#	AF17	O MAA0	W25	IO MD53	L11	P VCC
E04	IO CBE2#	M05	P GND	B24	IO HA27#	AB16	O MAA1	V26	IO MD54	L13	P VCC
C04	IO CBE3#	M11	P GND	C24	IO HA28#	AE17	O MAA2	U24	IO MD55	L14	P VCC
AC22	O CKE0#	M13	P GND	A23	IO HA29#	AC17	O MAA3	U23	IO MD56	L16	P VCC
AF23	O CKE1#	M14	P GND	E22	IO HA30#	AF18	O MAA4	T22	IO MD57	M12	P VCC
AE24	O CKE2#	M16	P GND	D23	IO HA31#	AE19	O MAA5	T23	IO MD58	M15	P VCC
AD23	O CKE3#	N01	P GND	N23	I HCLK	AF19	O MAA6	T26	IO MD59	N11	P VCC
AC23	O CKE4#	N12	P GND	B22	IO HD00#	AC18	O MAA7	R24	IO MD60	N16	P VCC
AF24	O CKE5#	N13	P GND	D22	IO HD01#	AC19	O MAA8	R25	IO MD61	N26	P VCC
B23	O CPURST#	N14	P GND	E21	IO HD02#	AE20	O MAA9	P23	IO MD62	P01	P VCC
M26	O CPURSTD#	N15	P GND	A22	IO HD03#	AD20	O MAA10	N25	IO MD63	P11	P VCC
L23	IO DBSY#	N24	P GND	D21	IO HD04#	AF21	O MAA11	AF11	IO MECC0	P16	P VCC
AB21	O DCLKO	P12	P GND	C21	IO HD05#	AC21	O MAA12	AD12	IO MECC1	R12	P VCC
AD25	I DCLKWR	P13	P GND	A21	IO HD06#	AF25	O MAA13	AA25	IO MECC2	R15	P VCC
J26	IO DEFER#	P14	P GND	C20	IO HD07#	AB22	O MAA14/DCKR	Y22	IO MECC3	T11	P VCC
F03	IO DEVSEL#	P15	P GND	B21	IO HD08#	AD16	O MAB0#	AE11	IO MECC4	T13	P VCC
K23	IO DRDY#	P26	P GND	E20	IO HD09#	AC16	O MAB1#	AA10	IO MECC5	T14	P VCC
E01	IO FRAME#	R05	P GND	A20	IO HD10#	AD17	O MAB2#	AA23	IO MECC6	T16	P VCC
AB02	IO GBE0#	R11	P GND	E19	IO HD11#	AB17	O MAB3#	AA26	IO MECC7	V06	P VCC
Y04	IO GBE1#	R13	P GND	B20	IO HD12#	AE18	O MAB4#	P22	- NC	V21	P VCC
V04	IO GBE2#	R14	P GND	E18	IO HD13#	AD19	O MAB5#	AE22	- NC	AA07	P VCC
U02	IO GBE3#	R16	P GND	D20	IO HD14#	AB18	O MAB6# / strap	AE23	- NC	AA09	P VCC
N05	I GCLK	R22	P GND	D19	IO HD15#	AB19	O MAB7# / strap	G05	IO PAR	AA18	P VCC
P05	O GCLKO	T12	P GND	D18	IO HD16#	AF20	O MAB8# / strap	C02	P PCIREF	AA20	P VCC
AB05	IO GD00	T15	P GND	C19	IO HD17#	AC20	O MAB9# / strap	AC04	O PCKRUN#	AE01	P VCC
AE02	IO GD01	V03	P GND	B19	IO HD18#	AB20	O MAB10 / strap	B02	I PCLK	AE26	P VCC
AD03	IO GD02	V24	P GND	A18	IO HD19#	AE21	O MAB11# / strap	D06	O PGNT#	AF02	P VCC
AD02	IO GD03	AA06	P GND	A19	IO HD20#	AD21	O MAB12# / strap	B06	I PREQ#	AF14	P VCC
AD01	IO GD04	AA08	P GND	B18	IO HD21#	AE22	O MAB13#	AF03	PWROK	N22	P VCCA
AC03	IO GD05	AA19	P GND	C17	IO HD22#	AC05	IO MD00	AB14	O RASA0# / CSA0#	Y06	P VCCA
AC01	IO GD06	AA21	P GND	E17	IO HD23#	AE05	IO MD01	AF15	O RASA1# / CSA1#	Y21	P VCCA
AB04	IO GD07	AB03	P GND	D17	IO HD24#	AB06	IO MD02	AE15	O RASA2# / CSA2#	M24	P VTT
AB01	IO GD08	AB12	P GND	B17	IO HD25#	AC06	IO MD03	AC15	O RASA3# / CSA3#	F17	P VTT
AA05	IO GD09	AB15	P GND	C16	IO HD26#	AF06	IO MD04	AD15	O RASA4# / CSA4#	AE03	O WSC#

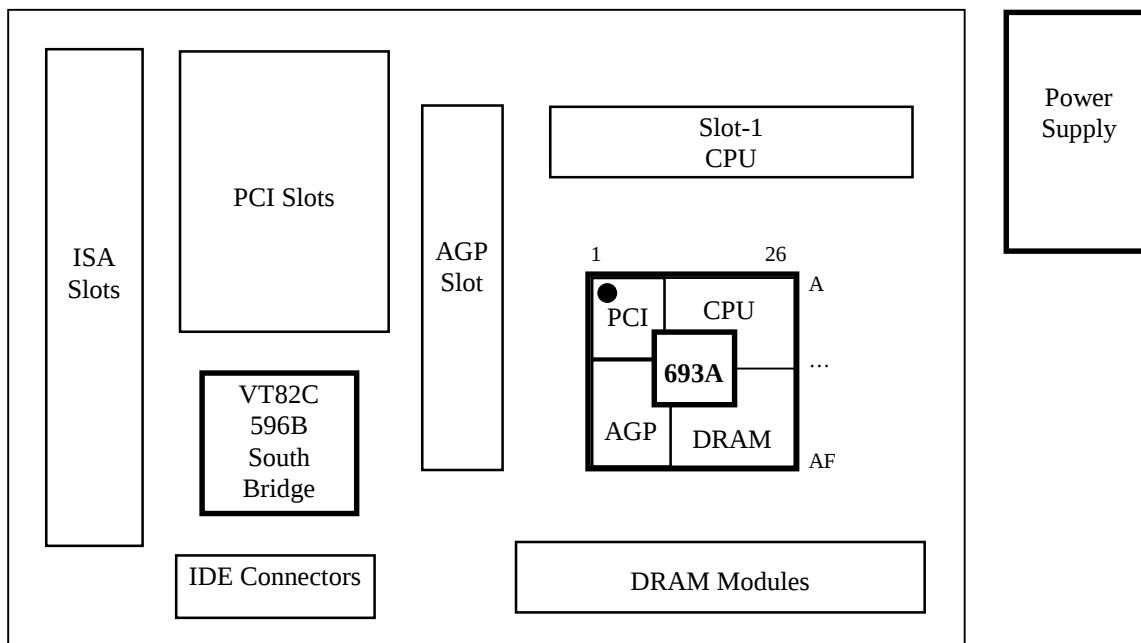
PIN DESCRIPTIONS

Table 1. VT82C693A Pin Descriptions

CPU Interface																					
Signal Name	Pin #	I/O	Signal Description																		
HA[31:3]#	(see pinout tables)	IO	Host Address Bus. HA[31:3] connect to the address bus of the host CPU. During CPU cycles HA[31:3] are inputs. These signals are driven by the VT82C693A during cache snooping operations.																		
HD[63:0]#	(see pinout tables)	IO	Host CPU Data. These signals are connected to the CPU data bus.																		
ADS#	K21	IO	Address Strobe. The CPU asserts ADS# in T1 of the CPU bus cycle.																		
BNR#	H24	IO	Block Next Request. Used to block the current request bus owner from issuing new requests. This signal is used to dynamically control the processor bus pipeline depth.																		
BPRI#	H26	IO	Priority Agent Bus Request. The owner of this signal will always be the next bus owner. This signal has priority over symmetric bus requests and causes the current symmetric owner to stop issuing new transactions unless the HLOCK# signal is asserted. The VT82C693A drives this signal to gain control of the processor bus.																		
DBSY#	L23	IO	Data Bus Busy. Used by the data bus owner to hold the data bus for transfers requiring more than one cycle.																		
DEFER#	J26	IO	Defer. The VT82C693A uses a dynamic deferring policy to optimize system performance. The VT82C693A also uses the DEFER# signal to indicate a processor retry response.																		
DRDY#	K23	IO	Data Ready. Asserted for each cycle that data is transferred.																		
HIT#	L24	IO	Hit. Indicates that a cacheing agent holds an unmodified version of the requested line. Also driven in conjunction with HITM# by the target to extend the snoop window.																		
HITM#	L22	I	Hit Modified. Asserted by the CPU to indicate that the address presented with the last assertion of EADS# is modified in the L1 cache and needs to be written back.																		
HLOCK#	K22	I	Host Lock. All CPU cycles sampled with the assertion of HLOCK# and ADS# until the negation of HLOCK# must be atomic.																		
HREQ[4:0]#	J25, K25, K24, J23, J22	IO	Request Command. Asserted during both clocks of the request phase. In the first clock, the signals define the transaction type to a level of detail that is sufficient to begin a snoop request. In the second clock, the signals carry additional information to define the complete transaction type.																		
BREQ0#	B26	O	Bus Request 0. Bus request output to CPU.																		
HTRDY#	H25	IO	Host Target Ready. Indicates that the target of the processor transaction is able to enter the data transfer phase.																		
RS[2:0]#	L25, L26, K26	IO	Response Signals. Indicates the type of response per the table below: <table><tr><th>RS[2:0]#</th><th>Response type</th></tr><tr><td>000</td><td>Idle State</td></tr><tr><td>001</td><td>Retry Response</td></tr><tr><td>010</td><td>Defer Response</td></tr><tr><td>011</td><td>Reserved</td></tr><tr><td>100</td><td>Hard Failure</td></tr><tr><td>101</td><td>Normal Without Data</td></tr><tr><td>110</td><td>Implicit Writeback</td></tr><tr><td>111</td><td>Normal With Data</td></tr></table>	RS[2:0]#	Response type	000	Idle State	001	Retry Response	010	Defer Response	011	Reserved	100	Hard Failure	101	Normal Without Data	110	Implicit Writeback	111	Normal With Data
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CPURST#	B23	O	CPU Reset. Reset output to CPU.																		
CPURSTD#	M26	O	CPU Reset Delayed. Reset output to CPU delayed by 2T.																		

Note: Clocking of the CPU and cache interfaces is performed with HCLK. See the clock pin group at the end of the pin descriptions section for descriptions of the clock input pins.

The VT82C693A pinouts were defined assuming the ATX PCB layout model shown below (and general pin layout shown) as a guide for PCB component placement. Other PCB layouts (AT, LPX, and NLX) were also considered and can typically follow the same general component placement.



DRAM Interface																											
Signal Name	Pin #	I/O	Signal Description																								
MD[63:0]	(see pinout tables)	IO	Memory Data. These signals are connected to the DRAM data bus. Note: MD0 is internally pulled up for use in EDO memory type detection.																								
MECC[7:0]	AA26, AA23, AA10, AE11, Y22, AA25, AD12, AF11	IO	DRAM ECC or EC Data (Rx78[0]=0)																								
MAA[14] / DCLKRD, MAA[13:0]	AB22, AF25, AC21, AF21, AD20, AE20, AC19, AC18, AF19, AE19, AF18, AC17, AE17, AB16, AF17	O / I O	Memory Address A. DRAM address lines (two sets for better drive). There are 15 address lines to provide support for 256Mb SDRAMs.																								
MAB[13]#, MAB[12]# / strap, MAB[11]# / strap, MAB[10] / strap, MAB[9]# / strap, MAB[8]# / strap, MAB[7]# / strap, MAB[6]# / strap, MAB[5:0]#	AF22, AD21, AE21, AB20, AC20, AF20, AB19, AB18, AD19, AE18, AB17, AD17, AC16, AD16	O	Memory Address B. DRAM address lines (two sets for better drive). Note that this set of memory address pins is opposite polarity from the “A” set (except for MAB10 which must be positive polarity because it is used for the SDRAM Precharge command). Selected pins are also used for strap options: <table><tr><th></th><th>Bit</th><th>Internal PU/PD</th></tr><tr><td>MAB12#</td><td>CPU Bus Frequency Select 0</td><td>Rx68[0] PD</td></tr><tr><td>MAB11#</td><td>In-Order Queue Depth Enable</td><td>Rx50[7] PU</td></tr><tr><td>MAB10</td><td>Quick Start Select</td><td>Rx52[5] PD</td></tr><tr><td>MAB9#</td><td>AGP Disable</td><td>RxAC[7] PD</td></tr><tr><td>MAB8#</td><td>CPU Bus Frequency Select 1</td><td>Rx68[1] PD</td></tr><tr><td>MAB7#</td><td>Memory Module Configuration</td><td>Rx6B[4] PD</td></tr><tr><td>MAB6#</td><td>GTL I/O Buffer Pullup</td><td>Rx52[7] PD</td></tr></table>		Bit	Internal PU/PD	MAB12#	CPU Bus Frequency Select 0	Rx68[0] PD	MAB11#	In-Order Queue Depth Enable	Rx50[7] PU	MAB10	Quick Start Select	Rx52[5] PD	MAB9#	AGP Disable	RxAC[7] PD	MAB8#	CPU Bus Frequency Select 1	Rx68[1] PD	MAB7#	Memory Module Configuration	Rx6B[4] PD	MAB6#	GTL I/O Buffer Pullup	Rx52[7] PD
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MAB6#	GTL I/O Buffer Pullup	Rx52[7] PD																									
RASA[5:0]# / CSA[5:0]#	AE16, AD15, AC15, AE15, AF15, AB14	O	Multifunction Pins (two sets for better drive) 1. FPG/EDO DRAM: Row Address Strobe of each bank. 2. Synchronous DRAM: Chip select of each bank..																								
RASB[5:0]# / CSB[5:0]#	AB23, AC26, AC24, AD26, AD24, AE25	O	Multifunction Pins (two sets for better drive) 1. FPG/EDO DRAM: Row Address Strobe of each bank. 2. Synchronous DRAM: Chip select of each bank..																								
CASA[7:0]# / DQMA[7:0]#	AB26, AC25, AC13, AD13, AA24, AA22, AC14, AE14	O	Multifunction Pins 1. FPG/EDO DRAM: Column Address Strobe of each byte lane. 2. Synchronous DRAM: Data mask of each byte lane.																								
CASB5# / DQMB5#, CASB1# / DQMB1#	AE13, AD14	O	Multifunction Pins 1. FPG/EDO DRAM 2. Synchronous DRAM																								
SRASA#, SRASB#	AF16, AA17	O	Row Address Command Indicator. (two sets for better drive)																								
SCASA#, SCASB#	AF12, AB13	O	Column Address Command Indicator. (two sets for better drive)																								
SWEA# / MWEA#, SWEB# / MWEB#	AE12, AC12	O	Write Enable Command Indicator. (two sets for better drive)																								
CKE0# / FENA, CKE1# / GCKE#, CKE2# / CSB6#, CKE3# / CSB7#, CKE4# / CSA6#, CKE5# / CSA7#	AC22, AF23, AE24, AD23, AC23, AF24	O	Clock Enables. Clock enables for each DRAM bank (Rx78[0]=1) for powering down the SDRAMs in notebook applications. Also used in desktop systems for clock control for reducing power usage and for reducing heat/temperature in high-speed memory systems. Alternate functions: FENA = FET Enable, GCKE# = Global CKE.																								

PCI Bus Interface			
Signal Name	Pin #	I/O	Signal Description
AD[31:0]	(see pinout tables)	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.
CBE[3:0]#	C4, E4, G3, J4	IO	Command/Byte Enable. Commands are driven with FRAME# assertion. Byte enables corresponding to supplied or requested data are driven on following clocks.
FRAME#	E1	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#	E2	IO	Initiator Ready. Asserted when the initiator is ready for data transfer.
TRDY#	F5	IO	Target Ready. Asserted when the target is ready for data transfer.
STOP#	F4	IO	Stop. Asserted by the target to request the master to stop the current transaction.
DEVSEL#	F3	IO	Device Select. This signal is driven by the VT82C693A when a PCI initiator is attempting to access main memory. It is an input when the VT82C693A is acting as a PCI initiator.
PAR	G5	IO	Parity. A single parity bit is provided over AD[31:0] and C/BE[3:0].
SERR#	F1	IO	System Error. VT82C693A will pulse this signal when it detects a system error condition.
LOCK#	F2	IO	Lock. Used to establish, maintain, and release resource lock.
PREQ#	B6	I	South Bridge Request. This signal comes from the South Bridge. PREQ# is the South Bridge request for the PCI bus.
PGNT#	D6	O	South Bridge Grant. This signal driven by the VT82C693A to grant PCI access to the South Bridge.
REQ[4:0]#	D10, D8, F10, C7, A3	I	PCI Master Request. PCI master requests for PCI.
GNT[4:0]#	E9, E8, E10, D7, E7	O	PCI Master Grant. Permission is given to the master to use PCI.
WSC#	AE03	O	Write Snoop Complete. Sideband PCI signal (used on the planar only in multiprocessor configurations) asserted 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 send an APIC interrupt message. Basically this signal is always active except when PCI master write data is not flushed.

Note: Clocking of the PCI interface is performed with PCLK; see the clock pin group at the end of the pin descriptions section for descriptions of the clock input pins.

AGP Bus Interface			
Signal Name	Pin #	I/O	Signal Description
GD[31:0]	(see pinout tables)	IO	Address/Data Bus. The standard AGP/PCI address and data lines. The address is driven with GDS0# and GDS1# assertion for AGP transfers and is driven with GFRM# assertion for PCI transfers.
GDS0#	AC2	IO	Bus Strobe 0 (AGP transactions only). Provides timing for 2x data transfer mode on AD[15:0]. The agent that is providing the data drives this signal.
GDS1#	T5	IO	Bus Strobe 1 (AGP transactions only). Provides timing for 2x data transfer mode on AD[31:16]. The agent that is providing the data drives this signal.
GBE[3:0]#	U2, V4, Y4, AB2	IO	Command/Byte Enable. AGP: These pins provide command information (different commands than for PCI) driven by the master (graphics controller) when requests are being enqueued using PIPE#. These pins provide valid byte information during AGP write transactions and are driven by the master. The target (this chip) drives these lines to "0000" during the return of AGP read data, but the state of these pins is ignored by the AGP master. PCI: Commands are driven with GFRM# assertion. Byte enables corresponding to supplied or requested data are driven on following clocks.
GFRM#	W3	IO	Frame (PCI transactions only). Assertion indicates the address phase of a PCI transfer. Negation indicates that one more data transfer is desired by the cycle initiator.
GIRDY#	V5	IO	Initiator Ready AGP: For write operations, the assertion of this pin indicates that the master is ready to provide <i>all</i> write data for the current transaction. Once this pin is asserted, the master is not allowed to insert wait states. For read operations, the assertion of this pin indicates that the master is ready to transfer a subsequent block of read data. The master is <i>never</i> allowed to insert a wait state during the initial block of a read transaction. However, it may insert wait states after each block transfers. PCI: Asserted when the initiator is ready for data transfer.
GTRDY#	W4	IO	Target Ready: AGP: Indicates that the target is ready to provide read data for the entire transaction (when the transaction can complete within four clocks) or is ready to transfer a (initial or subsequent) block of data when the transfer requires more than four clocks to complete. The target is allowed to insert wait states after each block transfers on both read and write transactions. PCI: Asserted when the target is ready for data transfer.
GSTOP#	Y1	IO	Stop (PCI transactions only). Asserted by the target to request the master to stop the current transaction.
GDSEL#	W5	IO	Device Select (PCI transactions only). This signal is driven by the VT82C693A when a PCI initiator is attempting to access main memory. It is an input when the VT82C693A is acting as PCI initiator. Not used for AGP cycles.

Note: Clocking of the AGP interface is performed with GCLK; see the clock pin group for descriptions of the clock input pins.

Note: PCB Layout Guidelines (reference from AGP specification)

- Total motherboard trace length 10" max, trace impedance = 65 ohms $\pm$ 15 ohms, minimize signal crosstalk
- Trace lengths within groups matched to within 2 inches or better
Groups are:
 - GDS0#, GD15-0, GBE1-0#
 - GDS1#, GD31-16, GBE3-2#
 - SBS#, SBA7-0
- Ground isolation should be provided around GDS0# and GDS1# to prevent crosstalk with GD[31:0]. Ideally ground traces should be provided adjacent to GDSn# on the same signal layer, but at a minimum wider spaces should be provided on either side (e.g., 16 mil spaces on either side of GDSn# if GDSn# signal traces are 8 mil).

AGP Bus Interface (continued)			
Signal Name	Pin #	IO	Signal Description
GPIPE#	M3	I	Pipelined Request. Asserted by the master (graphics controller) to indicate that a full-width request is to be enqueued by the target VT82C693A. The master enqueues one request each rising edge of GCLK while PIPE# is asserted. When PIPE# is deasserted no new requests are enqueued across the AD bus.
GRBF#	M4	I	Read Buffer Full. Indicates if the master (graphics controller) is ready to accept previously requested low priority read data. When RBF# is asserted, the VT82C693A will not return low priority read data to the master.
SBA[7:0]	R1, P3, P4, P2, N2, M1, M2, K1	I	SideBand Address. Provides an additional bus to pass address and command information from the master (graphics controller) to the target (the VT82C693A). These pins are ignored until enabled.
SBS#	N3	I	Sideband Strobe. Provides timing for SBA[7:0] (driven by the master)
ST[2:0]	L1, L2, L4	O	Status (AGP only). Provides information from the arbiter to a master to indicate what it may do. Only valid while GGNT# is asserted. 000 Indicates that previously requested low priority read or flush data is being returned to the master (graphics controller). 001 Indicates that previously requested high priority read data is being returned to the master. 010 Indicates that the master is to provide low priority write data for a previously enqueued write command. 011 Indicates that the master is to provide high priority write data for a previously enqueued write command. 100 Reserved. (arbiter must not issue, may be defined in the future). 101 Reserved. (arbiter must not issue, may be defined in the future). 110 Reserved. (arbiter must not issue, may be defined in the future). 111 Indicates that the master (graphics controller) has been given permission to start a bus transaction. The master may enqueue AGP requests by asserting PIPE# or start a PCI transaction by asserting GFRM#. ST[2:0] are always outputs from the VT82C693A and inputs to the master.
GREQ#	L5	I	Request. Master request for AGP.
GGNT#	L3	O	Grant. Permission is given to the master to use AGP.
GPAR / GCKRUN#	Y2	IO O	Rx78[1]=0: AGP Parity. A single parity bit is provided over GD[31:0] and GBE[3:0]. Rx78[1]=1: AGP Clock Run. Used to stop the AGP bus clock to reduce bus power usage.

Note: For PCI operation on the AGP bus, the following pins are not required:

- PERR# (parity and error reporting not required on transient data devices such as graphics controllers)
- LOCK# (no lock requirement on AGP)
- IDSEL (internally connected to AD16 on AGP-compliant masters)

Note: Separate system interrupts are not provided for AGP. The AGP connector provides interrupts via PCI bus INTA-B#.

Note: The AGP bus supports only one master directly (REQ[3:0]# and GNT[3:0]# are not provided). External logic is required to implement additional master capability. Note that the arbitration mechanism on the AGP bus is different from the PCI bus.

Note: A separate reset is not required for the AGP bus (RESET# resets both PCI and AGP buses)

Note: Two mechanisms are provided by the AGP bus to enqueue master requests: GPIPE# (to send addresses multiplexed on the AD lines) and the SBA port (to send addresses unmultiplexed). AGP masters implement one or the other or select one at initialization time (they are not allowed to change during runtime). Therefore only one of the two will be used and the signals associated with the other will not be used. Therefore the VT82C693A has an internal pullup on GRBF# to maintain it in the de-asserted state in case it is not implemented on the master device.

Clock / Reset Control																													
Signal Name	Pin #	I/O	Signal Description																										
HCLK	N23	I	Host Clock. This pin receives the host CPU clock (66 / 100 MHz). This clock is used by all VT82C693A logic that is in the host CPU domain. The memory interface logic will also use this clock if selected (memory system timing can alternately be selected to use the AGP bus clock). The CPU clock must lead the AGP clock by 0.2 ± 0.5 nsec.																										
PCLK	B2	I	PCI Clock. This pin receives a buffered host clock divided-by-2 or 3 to create 33 MHz. This clock is used by all of the VT82C693A logic that is in the PCI clock domain. This clock input must be 33 MHz maximum to comply with PCI specification requirements and must be synchronous with the host CPU clock, HCLK, with an HCLK:PCLK frequency ratio of 2:1 or 3:1 as shown in the table below. The host CPU clock must lead the PCI clock by 1.5 ± 0.5 nsec. Typical Clock Frequency Combinations <table><tr><th>Rx68[1:0]</th><th>Mode</th><th>Host Clock</th><th>AGP Clock</th><th>PCI Clock</th></tr><tr><td>00</td><td>2x</td><td>66 MHz</td><td>66 MHz</td><td>33 MHz</td></tr><tr><td>01</td><td>3x</td><td>100 MHz</td><td>66 MHz</td><td>33 MHz</td></tr><tr><td>10</td><td>4x</td><td>133 MHz</td><td>66 MHz</td><td>33 MHz</td></tr><tr><td>11</td><td colspan="4">Reserved</td></tr></table>		Rx68[1:0]	Mode	Host Clock	AGP Clock	PCI Clock	00	2x	66 MHz	66 MHz	33 MHz	01	3x	100 MHz	66 MHz	33 MHz	10	4x	133 MHz	66 MHz	33 MHz	11	Reserved			
Rx68[1:0]	Mode	Host Clock	AGP Clock	PCI Clock																									
00	2x	66 MHz	66 MHz	33 MHz																									
01	3x	100 MHz	66 MHz	33 MHz																									
10	4x	133 MHz	66 MHz	33 MHz																									
11	Reserved																												
GCLK	N5	I	AGP Clock. This pin receives the AGP bus clock (66 MHz). This clock is used by all VT82C693A logic that is in the AGP clock domain. The AGP clock must be synchronous / pseudo-synchronous to the host CPU clock (selectable as shown in the table below). The CPU clock must lead the AGP clock by 0.2 ± 0.5 nsec.																										
GCLKO	P5	O	AGP Clock Feedback.																										
DCLKO	AB21	O	DRAM Clock. Output from internal clock generator to the external clock buffer.																										
DCLKWR	AD25	I	DRAM Clock Input. Input from the external clock buffer.																										
DCLKRD / MAA14	AB22	I / O	DRAM Clock Input. No function (used for chip test). MAA14 if Rx69[5]=1																										
RESET#	A6	I	Reset. Input from south bridge chip. When asserted, this signal resets the VT82C693A and sets all register bits to the default value. The same signal that connects to this pin may also be used (connected through an external inverter) to reset the ISA bus (if implemented). The rising edge of this signal is used to sample all power-up strap options (see HA25-27).																										
PWROK	AF3	I	Power OK.																										
CPURST#	B23	O	CPU Reset. CPU Reset output to the CPU.																										
CPURSTD#	M26	O	CPU Reset Delayed. Reset output delayed 2T from CPURST#. Used to enable an external LV244 buffer for fraction / ratio selection.																										
SUSTAT#	AD4	I	Suspend Status. For implementation of the Suspend-to-DRAM feature. Connect to an external pullup to disable.																										
PCKRUN#	AC4	O	PCI Clock Run. Used to stop the PCI bus clock to reduce bus power usage.																										
GCKRUN# / GPAR	Y2	O / IO	Rx78[1]=1: AGP Clock Run. Used to stop the AGP bus clock to reduce bus power usage. Rx78[1]=0: AGP Parity. A single parity bit is provided over GD[31:0] and GBE[3:0].																										

Power, Ground, No Connects, and Test			
<u>Signal Name</u>	<u>Pin #</u>	<u>I/O</u>	<u>Signal Description</u>
VCC	(see pin list)	P	Power for Internal Logic (3.3V $\pm$ 5%).
GND	(see pin list)	P	Ground
VCCA	N22, Y6, Y21	P	Analog Power (3.3V $\pm$ 5%). For internal clock logic.
GNDA	M22, W6, W21	P	Analog Ground. For internal clock logic. Connect to main ground plane.
VTT	F17, M24	P	CPU Interface Termination Voltage (1.5V $\pm$ 10%).
GTLREF	E16, M23	P	CPU Interface GTL+ Voltage Reference. 2/3 VTT $\pm$ 2%
AGPREF	N4	P	AGP Voltage Reference. 0.39 VCC to 0.41 VCC. Typical value is 1.32V (0.40 times 3.3V). This can be provided with a resistive divider on VCC using 270 ohm and 180 ohm (2%) resistors.
PCIREF	C2	P	PCI Voltage Reference. Reference voltage for 5V input tolerance.
NC	P22, AE22, AE23	-	No Connect.
TESTIN#	M25	I	Test Input. NAND tree / tristate mode test select.

REGISTERS

Register Overview

The following tables summarize the configuration and I/O registers of the VT82C693A. 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 following these tables for details). All offset and default values are shown in hexadecimal unless otherwise indicated.

Table 2. VT82C693A Registers

VT82C693A I/O Ports

Port #	I/O Port	Default	Acc
22	PCI / AGP Arbiter Disable	00	RW
CFB-8	Configuration Address	0000 0000	RW
CFF-C	Configuration Data	0000 0000	RW

VT82C693A Device 0 Registers - Host Bridge
Header Registers

Offset	Configuration Space Header	Default	Acc
1-0	Vendor ID	1106	RO
3-2	Device ID	0691	RO
5-4	Command	0006	RW
7-6	Status	0290	WC
8	Revision ID	40	RO
9	Program Interface	00	RO
A	Sub Class Code	00	RO
B	Base Class Code	06	RO
C	-reserved-	00	—
D	Latency Timer	00	RW
E	Header Type	00	RO
F	Built In Self Test (BIST)	00	RO
13-10	Graphics Aperture Base	0000 0008	RW
14-27	-reserved-	00	—
28-2B	-reserved-	00	—
2D-2C	Subsystem Vendor ID	0000	W1
2F-2E	Subsystem ID	0000	W1
30-33	-reserved-	00	—
37-34	Capability Pointer	0000 00A0	RO
38-3F	-reserved-	00	—

Device-Specific Registers

Offset	Host CPU Protocol Control	Default	Acc
50	Request Phase Control	00	RW
51	Response Phase Control	00	RW
52	Dynamic Defer Timer	10	RW
53	Miscellaneous	10	RW
55-54	-reserved-	00	—

Offset	DRAM Control	Default	Acc
59-58	MA Map Type	0040	RW
5F-5A	DRAM Row Ending Address:		
5A	Bank 0 Ending (HA[30:23])	01	RW
5B	Bank 1 Ending (HA[30:23])	01	RW
5C	Bank 2 Ending (HA[30:23])	01	RW
5D	Bank 3 Ending (HA[30:23])	01	RW
5E	Bank 4 Ending (HA[30:23])	01	RW
5F	Bank 5 Ending (HA[30:23])	01	RW
56	Bank 6 Ending (HA[30:23])	01	RW
57	Bank 7 Ending (HA[30:23])	01	RW
60	DRAM Type	00	RW
61	ROM Shadow Control C0000-CFFFF	00	RW
62	ROM Shadow Control D0000-DFFFF	00	RW
63	ROM Shadow Control E0000-FFFFF	00	RW
64	DRAM Timing for Banks 0,1	EC	RW
65	DRAM Timing for Banks 2,3	EC	RW
66	DRAM Timing for Banks 4,5	EC	RW
67	DRAM Timing for Banks 6,7	EC	RW
68	DRAM Control	00	RW
69	DRAM Clock Select	00	RW
6A	DRAM Refresh Counter	00	RW
6B	DRAM Arbitration Control	01	RW
6C	SDRAM Control	00	RW
6D	DRAM Control Drive Strength	00	RW
6E	ECC Control	00	RW
6F	ECC Status	00	RO

Device-Specific Registers (continued)

Offset	PCI Bus Control	Default	Acc
70	PCI Buffer Control	00	RW
71	CPU to PCI Flow Control 1	00	RW
72	CPU to PCI Flow Control 2	00	RW
73	PCI Master Control 1	00	RW
74	PCI Master Control 2	00	RW
75	PCI Arbitration 1	00	RW
76	PCI Arbitration 2	00	RW
77	Chip Test (do not program)	00	RW
78	PMU Control 1	00	RW
79	PMU Control 2	00	RW
7A	Miscellaneous Control	00	RW
79-7D	-reserved-	00	—
7E-7F	PLL Test Mode (do not program)	00	RW

Offset	GART/TLB Control	Default	Acc
83-80	GART/TLB Control	0000 0000	RW
84	Graphics Aperture Size	00	RW
85-87	-reserved-	00	—
8B-88	Gr. Aperture TLB Base Register Base	0000 0000	RW
8C-9F	-reserved-	00	—

Offset	AGP Control	Default	Acc
A0	AGP ID	02	RO
A1	AGP Next Item Pointer	00	RO
A2	AGP Specification Revision	10	RO
A3	-reserved-	00	—
A7-A4	AGP Status	0700 0203	RO
AB-A8	AGP Command	0000 0000	RW
AC	AGP Control	08	RW
AD	AGP Latency Timer	02	RW
AF-AE	-reserved-	00	—

Offset	Miscellaneous Control	Default	Acc
B0-EF	-reserved-	00	—
F7-F0	BIOS Scratch Registers	00	RW
F8	DRAM Arbitration Timer	00	RW
F9-FB	-reserved-	00	—
FC	Back-door Control	00	RW
FD	-reserved-	00	—
FE-FE	Back-door Device ID	0000	RW

VT82C693A Device 1 - PCI-to-PCI Bridge
Header Registers

Offset	Configuration Space Header	Default	Acc
1-0	Vendor ID	1106	RO
3-2	Device ID	8698	RO
5-4	Command	0007	RW
7-6	Status	0220	WC
8	Revision ID	nn	RO
9	Program Interface	00	RO
A	Sub Class Code	04	RO
B	Base Class Code	06	RO
C	-reserved-	00	—
D	Latency Timer	00	RW
E	Header Type	01	RO
F	Built In Self Test (BIST)	00	RO
10-17	-reserved-	00	—
18	Primary Bus Number	00	RW
19	Secondary Bus Number	00	RW
1A	Subordinate Bus Number	00	RW
1B	-reserved-	00	—
1C	I/O Base	F0	RW
1D	I/O Limit	00	RW
1F-1E	Secondary Status	0000	RO
21-20	Memory Base	FFF0	RW
23-22	Memory Limit (Inclusive)	0000	RW
25-24	Prefetchable Memory Base	FFF0	RW
27-26	Prefetchable Memory Limit	0000	RW
3D-28	-reserved-	00	—
3F-3E	PCI-to-PCI Bridge Control	00	RW

Device-Specific Registers

Offset	AGP Control	Default	Acc
40	CPU-to-AGP Flow Control 1	00	RW
41	CPU-to-AGP Flow Control 2	00	RW
42	AGP Master Control	00	RW
43	AGP Master Latency Timer	00	RW
44	Back-Door Register Control	00	RW
45	-reserved-	00	—
47-46	P2P Bridge Device ID	0000	RW
48-7F	Reserved	00	—
80	Capability ID	01	RO
81	Next Pointer	00	RO
82	Power Management Capabilities 1	02	RO
83	Power Management Capabilities 2	00	RO
84	Power Management Control / Status	00	RW
85	Power Management Status	00	RO
86	PCI-PCI Bridge Support Extensions	00	RO
87	Power Management Data	00	RO
88-FF	Reserved	00	—

Miscellaneous I/O

One I/O port is defined in the VT82C693A: Port 22.

Port 22 – PCI / AGP Arbiter DisableRW

- 7-2 **Reserved** always reads 0
- 1 **AGP Arbiter Disable**
 - 0 Respond to GREQ# signaldefault
 - 1 Do not respond to GREQ# signal
- 0 **PCI Arbiter Disable**
 - 0 Respond to all REQ# signals.....default
 - 1 Do not respond to any REQ# signals, including PREQ#

This port can be enabled for read/write access by setting bit-7 of Device 0 Configuration Register 78.

Configuration Space I/O

All registers in the VT82C693A (listed above) are addressed via the following configuration mechanism:

Mechanism #1

These ports respond only to double-word accesses. Byte or word accesses will be passed on unchanged.

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

- 31 **Configuration Space Enable**
 - 0 Disabled..... default
 - 1 Convert configuration data port writes to configuration cycles on the PCI bus

30-24 **Reserved**always reads 0

23-16 PCI Bus Number

Used to choose a specific PCI bus in the system

15-11 Device Number

Used to choose a specific device in the system (devices 0 and 1 are defined for the VT82C693A)

10-8 Function Number

Used to choose a specific function if the selected device supports multiple functions (only function 0 is defined for the VT82C693A).

7-2 Register Number (also called the "Offset")

Used to select a specific DWORD in the VT82C693A configuration space

1-0 **Fixed**always reads 0

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

Refer to PCI Bus Specification Version 2.2 for further details on operation of the above configuration registers.

Register Descriptions

Device 0 Header Registers - Host Bridge

All registers are located in PCI configuration space. They should be programmed using PCI configuration mechanism 1 through CF8 / CFC with bus number, function number, and device number equal to zero.

Device 0 Offset 1-0 - Vendor ID (1106h).....RO

15-0 ID Code (reads 1106h to identify VIA Technologies)

Device 0 Offset 3-2 - Device ID (0691h).....RO

15-0 ID Code (reads 0691h to identify the VT82C693A)

Device 0 Offset 5-4 -Command (0006h).....RW

15-10 Reserved always reads 0

9 Fast Back-to-Back Cycle Enable RO

- 0 Fast back-to-back transactions only allowed to the same agentdefault
- 1 Fast back-to-back transactions allowed to different agents

8 SERR# Enable..... RO

- 0 SERR# driver disabled.....default
- 1 SERR# driver enabled

(SERR# is used to report parity errors if bit-6 is set).

7 Address / Data Stepping RO

- 0 Device never does stepping.....default
- 1 Device always does stepping

6 Parity Error Response.....RW

- 0 Ignore parity errors & continue.....default
- 1 Take normal action on detected parity errors

5 VGA Palette Snoop RO

- 0 Treat palette accesses normally.....default
- 1 Don't respond to palette accesses on PCI bus

4 Memory Write and Invalidate Command..... RO

- 0 Bus masters must use Mem Writedefault
- 1 Bus masters may generate Mem Write & Inval

3 Special Cycle Monitoring RO

- 0 Does not monitor special cyclesdefault
- 1 Monitors special cycles

2 Bus Master RO

- 0 Never behaves as a bus master
- 1 Can behave as a bus masterdefault

1 Memory Space..... RO

- 0 Does not respond to memory space
- 1 Responds to memory spacedefault

0 I/O Space RO

- 0 Does not respond to I/O spacedefault
- 1 Responds to I/O space

Device 0 Offset 7-6 - Status (0290h)..... RWC

15 Detected Parity Error

- 0 No parity error detected default
- 1 Error detected in either address or data phase.
This bit is set even if error response is disabled (command register bit-6).write one to clear

14 Signaled System Error (SERR# Asserted)

..... always reads 0

13 Signaled Master Abort

- 0 No abort received default
- 1 Transaction aborted by the master
.....write one to clear

12 Received Target Abort

- 0 No abort received default
- 1 Transaction aborted by the target.....
.....write one to clear

11 Signaled Target Abort..... always reads 0

- 0 Target Abort never signaled

10-9 DEVSEL# Timing

- 00 Fast
- 01 Medium..... always reads 01
- 10 Slow
- 11 Reserved

8 Data Parity Error Detected

- 0 No data parity error detected default
- 1 Error detected in data phase. Set only if error response enabled via command bit-6 = 1 and VT82C693A was initiator of the operation in which the error occurred.write one to clear

7 Fast Back-to-Back Capable always reads 1

6 User Definable Features..... always reads 0

5 66MHz Capable..... always reads 0

4 Supports New Capability list always reads 1

3-0 Reserved always reads 0

Device 0 Offset 8 - Revision ID (4nh)..... RO

7-0 VT82C693A Chip Revision Code

Device 0 Offset 9 - Programming Interface (00h) RO

7-0 Interface Identifier always reads 00

Device 0 Offset A - Sub Class Code (00h)..... RO

7-0 Sub Class Codereads 00 to indicate Host Bridge

Device 0 Offset B - Base Class Code (06h)..... RO

7-0 Base Class Code ..reads 06 to indicate Bridge Device

Device 0 Offset D - Latency Timer (00h) RW

Specifies the latency timer value in PCI bus clocks.

7-3 Guaranteed Time Slice for CPU..... default=0

2-0 Reserved (fixed granularity of 8 clks) .. always read 0
Bits 2-1 are writeable but read 0 for PCI specification compatibility. The programmed value may be read back in Offset 75 bits 5-4 (PCI Arbitration 1).

Device 0 Host Bridge Header Registers (continued)
Device 0 Offset E - Header Type (00h).....RO

7-0 Header Type Codereads 00: single function

Device 0 Offset F - Built In Self Test (BIST) (00h).....RO

7 BIST Supportedreads 0: no supported functions

6-0 Reserved always reads 0

Device 0 Offset 13-10 - Graphics Aperture Base
(00000008h)RW

31-28 Upper Programmable Base Address Bits..... def=0

27-20 Lower Programmable Base Address Bits def=0

These bits behave as if hardwired to 0 if the corresponding Graphics Aperture Size register bit (Device 1 Offset 84h) is 0.

27	26	25	24	23	22	21	20	(This Register)
<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>0</u>	(Gr Aper Size)
RW	RW	RW	RW	RW	RW	RW	RW	1M
RW	RW	RW	RW	RW	RW	RW	0	2M
RW	RW	RW	RW	RW	RW	0	0	4M
RW	RW	RW	RW	RW	0	0	0	8M
RW	RW	RW	RW	0	0	0	0	16M
RW	RW	RW	0	0	0	0	0	32M
RW	RW	0	0	0	0	0	0	64M
RW	0	0	0	0	0	0	0	128M
0	0	0	0	0	0	0	0	256M

19-0 Reserved always reads 00008

Note: The locations in the address range defined by this register are prefetchable.

Device 0 Offset 2D-2C – Subsystem Vendor ID (0000h)R/W1

15-0 Subsystem Vendor ID..... default = 0

This register may be written once and is then read only.

Device 0 Offset 2F-2E – Subsystem ID (0000h)..... R/W1

15-0 Subsystem ID default = 0

This register may be written once and is then read only.

Device 0 Offset 37-34 - Capability Pointer (00000A0h) RO

Contains an offset from the start of configuration space.

31-0 AGP Capability List Pointer always reads A0h

Device 0 Configuration Registers - Host Bridge

These registers are normally programmed once at system initialization time.

Host CPU Control
Device 0 Offset 50 – Request Phase Control (00h)RW

- 7 CPU Hardwired IOQ (In Order Queue) Size**
 Default per strap on pin MAB11#During reset. This register can be written 0 to restrict the chip to one level of IOQ.
 0 1-Level
 1 4-Level
- 6 Read-Around-Write**
 0 Disabledefault
 1 Enable
- 5 Reserved** always reads 0
- 4 Defer Retry When HLOCK Active**
 0 Disabledefault
 1 Enable
 Note: always set this bit to 1
- 3-1 Reserved** always reads 0
- 0 CPU / PCI Master Read DRAM Timing**
 0 Start DRAM read after snoop complete def
 1 Start DRAM read before snoop complete

Table 3. Rx50 Programming Constraints

Bit-5	Bit-3	Bit-2	Remark
0	1	0	CPU-to-PCI Read Retry Only
0	1	1	CPU-to-PCI Read Retry / Defer
1	1	0	CPU-to-PCI Read / Write Retry
1	1	1	CPU-to-PCI Read Retry / Defer (normal operation mode)

Device 0 Offset 51 – Response Phase Control (00h)..... RW

- 7 CPU Read DRAM 0ws for Back-to-Back Read Transactions**
 0 Disable..... default
 1 Enable
 Setting this bit enables maximum read performance by allowing continuous 0 wait state reads for pipelined line reads. If this bit is not set, there will be at least 1T idle time between read transactions.
- 6 CPU Write DRAM 0ws for Back-to-Back Write Transactions**
 0 Disable..... default
 1 Enable
 Setting this bit enables maximum write performance by allowing continuous 0 wait state writes for pipelined line writes and sustained 3T single writes. If this bit is not set, there will be at least 1T idle time between write transactions.
- 5 Reserved** always reads 0
- 4 Fast Response (HIT/HITM sample 1T earlier)**
 0 Disable..... default
 1 Enable
- 3 Non-Posted IOW**
 0 Disable..... default
 1 Enable
- 2-1 Reserved** always reads 0
- 0 Concurrent PCI Master / Host Operation**
 0 Disable – the CPU bus will be occupied (BPRI asserted) during the entire PCI operation..... def
 1 Enable – the CPU bus is only requested before ADS# assertion

Device 0 Offset 52 – Dynamic Defer Timer (10h)RW

- 7 **GTL I/O Buffer Pullup** default = MAB6# Strap
0 Disable
1 Enable
The default value of this bit is determined by a strap on the MAB6# pin during reset.
- 6 **RAW: Write retire policy, after 2 writes**
0 Disable default
1 Enable
- 5 **Quick Start Select** default = MAB10 Strap
0 Disable
1 Enable
The default value of this bit is determined by a strap on the MAB10 pin during reset.
- 4-0 **Snoop Stall Count**
00 Disable dynamic defer
01-1F Snoop stall count default = 10h

Device 0 Offset 53 – Misc. (10h) RW

- 7 **HREQ enable**
0 Disable default
1 Enable
- 6 **DRAM Frequency Greater Than CPU FSB Freq.**
0 DRAM Frequency ≤ CPU FSB Freq. default
1 DRAM Frequency > CPU FSB Frequency
Setting this bit enables the DRAM subsystem to run at a higher frequency than the CPU FSB frequency. When setting this bit, Rx69[6] must also be set and only SDRAM memory type DIMM modules may be installed. A mix of EDO and SDRAM modules is not supported in this case.
- 5 **PCI/AGP Master-to-CPU / CPU-to-PCI/AGP Slave Concurrency**
0 Disable default
1 Enable
- 4 **HPRI Function Enable**
0 Disable default
1 Enable
- 3 **P6Lock Function Enable**
0 Disable default
1 Enable
- 2-0 **Reserved** always reads 0

DRAM Control

These registers are normally set at system initialization time and not accessed after that during normal system operation. Some of these registers, however, may need to be programmed using specific sequences during power-up initialization to properly detect the type and size of installed memory (refer to the VIA Technologies VT82C693A BIOS porting guide for details).

Table 4. System Memory Map

Space	Start	Size	Address Range	Comment
DOS	0	640K	00000000-0009FFFF	Cacheable
VGA	640K	128K	000A0000-000BFFFF	Used for SMM
BIOS	768K	16K	000C0000-000C3FFF	Shadow Ctrl 1
BIOS	784K	16K	000C4000-000C7FFF	Shadow Ctrl 1
BIOS	800K	16K	000C8000-000CBFFF	Shadow Ctrl 1
BIOS	816K	16K	000CC000-000CFFFF	Shadow Ctrl 1
BIOS	832K	16K	000D0000-000D3FFF	Shadow Ctrl 2
BIOS	848K	16K	000D4000-000D7FFF	Shadow Ctrl 2
BIOS	864K	16K	000D8000-000DBFFF	Shadow Ctrl 2
BIOS	880K	16K	000DC000-000DFFFF	Shadow Ctrl 2
BIOS	896K	64K	000E0000-000EFFFF	Shadow Ctrl 3
BIOS	960K	64K	000F0000-000FFFFF	Shadow Ctrl 3
Sys	1MB	—	00100000-DRAM Top	Can have hole
Bus	D Top		DRAM Top-FFFFFFF	
Init	4G-64K	64K	FFFEFFFF-FFFFFFFF	000Fxxxx alias

Device 0 Offset 59-58 - DRAM MA Map Type (0040h).RW

15-13 Bank 5/4 MA Map Type (see below)

12 **Reserved** (Bank 5/4 Virtual Channel Enable) ... def=0

11-9 Bank 7/6 MA Map Type (see below)

8 **Reserved** (Bank 7/6 Virtual Channel Enable) ... def=0

7-5 Bank 1/0 MA Map Type

- 000 8-bit Column Address
- 001 9-bit Column Address
- 010 10-bit Column Addressdefault
- 011 11-bit Column Address
- 100 12-bit Column Address (64Mb)
- 101 Reserved
- 11x Reserved

Bank 0/1 MA Map Type (SDRAM)

- 000 16Mbit SDRAMdefault
- 100 64Mbit SDRAM
- 101 Reserved
- 11x Reserved

4 **Reserved** (Bank 1/0 Virtual Channel Enable) ... def=0

3-1 Bank 3/2 MA Map Type (see above)

0 **Reserved** (Bank 3/2 Virtual Channel Enable) ... def=0

Device 0 Offset 5F-5A – DRAM Row Ending Address:

Offset 5A – Bank 0 Ending (HA[30:23]) (01h) RW

Offset 5B – Bank 1 Ending (HA[30:23]) (01h) RW

Offset 5C – Bank 2 Ending (HA[30:23]) (01h) RW

Offset 5D – Bank 3 Ending (HA[30:23]) (01h) RW

Offset 5E – Bank 4 Ending (HA[30:23]) (01h) RW

Offset 5F – Bank 5 Ending (HA[30:23]) (01h) RW

Offset 56 – Bank 6 Ending (HA[30:23]) (01h) RW

Offset 57 – Bank 7 Ending (HA[30:23]) (01h) RW

Note : BIOS is required to fill the ending address registers for all banks even if no memory is populated. The endings have to be in incremental order.

Device 0 Offset 60 – DRAM Type (00h)..... RW

7-6 DRAM Type for Bank 7/6

- 00 Fast Page Mode DRAM (FPG)..... default
- 01 EDO DRAM (EDO)
- 10 Reserved
- 11 SDRAM

5-4 **DRAM Type for Bank 5/4**.....default=FPG

3-2 **DRAM Type for Bank 3/2**.....default=FPG

1-0 **DRAM Type for Bank 1/0**.....default=FPG

Table 5. Memory Address Mapping Table

EDO/FP DRAM

MA:	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8-bit Col (000)		23	22	21	11	20	19	18	17	16	15	14	13	12	Row Bits Col Bits
9-bit Col (001)		24	23	22	21	20	19	18	17	16	15	14	13	12	Row Bits Col Bits
10-bit Col (010)		25	24	23	21	20	19	18	17	16	15	14	13	12	Row Bits Col Bits
11-bit Col (011)		26	25	23	21	20	19	18	17	16	15	14	13	12	Row Bits Col Bits
12-bit Col (100)		27	25	23	21	20	19	18	17	16	15	14	13	12	Row Bits Col Bits

SDRAM

MA:	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
16Mb (0xx)				11	22	21	20	19	18	17	16	15	14	13	12	Row Bits Col Bits
64Mb (100)	25/26/27	24	13	12	22	21	20	19	18	17	16	15	14	11	23	x4: 10 col x8: 9 col x16: 8 col x32: 8 col
2/4 bank																
4-bank x32																

"PC" = "Precharge Control" (refer to SDRAM specifications)

16Mb 11x10, 11x9, and 11x8 configurations supported

64Mb x4: 12x10 4bank, 13x10 2bank

x8: 12x9 4bank, 13x9 2bank

x16: 12x8 4bank, 13x8 2bank

x32: 11x8 4bank

Device 0 Offset 61 - Shadow RAM Control 1 (00h)RW

- 7-6 CC000h-CFFFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable
- 5-4 C8000h-CBFFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable
- 3-2 C4000h-C7FFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable
- 1-0 C0000h-C3FFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable

Device 0 Offset 62 - Shadow RAM Control 2 (00h)RW

- 7-6 DC000h-DFFFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable
- 5-4 D8000h-DBFFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable
- 3-2 D4000h-D7FFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable
- 1-0 D0000h-D3FFFh**
 00 Read/write disabledefault
 01 Write enable
 10 Read enable
 11 Read/write enable

Device 0 Offset 63 - Shadow RAM Control 3 (00h)..... RW

- 7-6 E0000h-EFFFFh**
 00 Read/write disable default
 01 Write enable
 10 Read enable
 11 Read/write enable
- 5-4 F0000h-FFFFFh**
 00 Read/write disable default
 01 Write enable
 10 Read enable
 11 Read/write enable
- 3-2 Memory Hole**
 00 None default
 01 512K-640K
 10 15M-16M (1M)
 11 14M-16M (2M)
- 1-0 SMI Mapping Control**
- | | <u>SMM</u> | | <u>Non-SMM</u> | |
|----|-------------|-------------|----------------|-------------|
| | <u>Code</u> | <u>Data</u> | <u>Code</u> | <u>Data</u> |
| 00 | DRAM | DRAM | PCI | PCI |
| 01 | DRAM | DRAM | DRAM | DRAM |
| 10 | DRAM | PCI | PCI | PCI |
| 11 | DRAM | DRAM | DRAM | DRAM |

Device 0 Offset 64 - DRAM Timing for Banks 0,1 (ECh)RW

Device 0 Offset 65 - DRAM Timing for Banks 2,3 (ECh)RW

Device 0 Offset 66 - DRAM Timing for Banks 4,5 (ECh)RW

Device 0 Offset 67 - DRAM Timing for Banks 6,7 (ECh)RW

EPG / EDO Settings for Registers 67-64

7	RAS Precharge Time	
	0	3T
	1	4Tdefault
6	RAS Pulse Width	
	0	4T
	1	5Tdefault
5-4	CAS Read Pulse Width	
	00	1T
	01	2T
	10	3Tdefault
	11	4T
	Note: EDO will not automatically reduce the CAS pulse width. For EDO type DRAMs, use 00 if CAS width = 1 is to be used.	
3	CAS Write Pulse Width	
	0	1T
	1	2Tdefault
2	MA-to-CAS Delay	
	0	1T
	1	2Tdefault
1	RAS to MA Delay	
	0	1Tdefault
	1	2T
0	Reserved	 always reads 0

SDRAM Settings for Registers 67-64

7	Precharge Command to Active Command Period	
	0	TRP = 2T
	1	TRP = 3T default
6	Active Command to Precharge Command Period	
	0	TRAS = 5T
	1	TRAS = 6T default
5-4	CAS Latency	
	00	1T
	01	2T
	10	3T default
	11	reserved
3	DIMM Type	
	0	Standard
	1	Registered default
2	ACTIVE Command to CMD Command Period / VCM Prefetch Read Latency	
	0	2T / 3T
	1	3T / 4T default
1-0	Bank Interleave	
	00	No Interleave default
	01	2-way
	10	4-way
	11	Reserved

Device 0 Offset 68 - DRAM Control (00h)RW

- 7 SDRAM Open Page Control**
 - 0 Always precharge SDRAM banks when accessing EDO/FPG DRAMs.....default
 - 1 SDRAM banks remain active when accessing EDO/FPG banks
- 6 Bank Page Control**
 - 0 Allow only pages of the same bank active.. def.
 - 1 Allow pages of different banks to be active
- 5 Reserved** always reads 0
- 4 DRAM Data Latch Delay for EDO/FPG DRAM**
 - 0 Latch DRAM data at CCLK rising edge def.
 - 1 Delay latch of DRAM data by ½ CCLK
- 3 EDO Test Mode**
 - 0 Disabledefault
 - 1 Enable
- 2 Burst Refresh**
 - 0 Disabledefault
 - 1 Enable (burst 4 times)
- 1 System Frequency Divider** RO
This bit is latched from MAB8# at the rising edge of RESET# (see table below).
- 0 System Frequency Divider** RO
This bit is latched from MAB12# at the rising edge of RESET#.
 - 00 CPU Frequency = 66 MHz
 - 01 CPU Frequency = 100 MHz
 - 10 CPU Frequency = 133 MHz
 - 11 Reserved

Note: See also Rx69[7-6]

Note: MD0 is internally pulled up for EDO detection.

Device 0 Offset 69 – DRAM Clock Select (00h) RW

- 7 DRAM Operating Frequency Slower Than CPU**
 - 0 DRAM Same As or Equal to CPU..... default
 - 1 DRAM Slower Than CPU by 33 MHz
 - 6 DRAM Operating Frequency Faster Than CPU**
 - 0 DRAM Same As or Equal to CPU..... default
 - 1 DRAM Faster Than CPU by 33 MHz
- | Rx68[1-0] | Rx69[7-6] | CPU / DRAM |
|-----------|-----------|---------------|
| 00 | 00 | 66 / 66 (def) |
| 00 | 01 | 66 / 100 |
| 01 | 10 | 100 / 66 |
| 01 | 00 | 100 / 100 |
| 01 | 01 | 100 / 133 |
| 10 | 10 | 133 / 100 |
| 10 | 00 | 133 / 133 |
- 5 256M bit DRAM Support**RW
 - 0 Disable..... default
 - 1 Enable (DCLKRD becomes output)
 - 4 DRAMC Command Register Output**
 - 0 Disable..... default
 - 1 Enable
 - 3 Fast DRAM Precharge for Different Bank**
 - 0 Disable..... default
 - 1 Enable
 - 2 DRAM 4K Page Enable (for 64Mbit DRAM)**
 - 0 Disable..... default
 - 1 Enable
 - 1 DIMM Register Support**.....RW
 - 0 Disable..... default
 - 1 Enable
 - 0 Reserved**always reads 0

Device 0 Offset 6A - Refresh Counter (00h).....RW

- 7-0 Refresh Counter** (in units of 16 CPUCLKs)
- 00 DRAM Refresh Disableddefault
 - 01 32 CPUCLKs
 - 02 48 CPUCLKs
 - 03 64 CPUCLKs
 - 04 80 CPUCLKs
 - 05 96 CPUCLKs
 -

The programmed value is the desired number of 16-CPUCLK units minus one.

Device 0 Offset 6B - DRAM Arbitration Control (01h) RW

- 7-6 Arbitration Parking Policy**
- 00 Park at last bus owner default
 - 01 Park at CPU side
 - 10 Park at AGP side
 - 11 Reserved
- 5 Fast Read to Write turn-around**
- 0 Disable..... default
 - 1 Enable
- 4 Memory Module ConfigurationRO**
- 0 Normal Operation..... default
 - 1 Unused Outputs Tristated (RASB#, CASB#, CKE, MAB, DCLKO)
- This bit is latched from MAB7# at the rising edge of RESET#.
- 3 MD Bus Second Level Strength Control**
- 0 Normal slew rate..... default
 - 1 More slew rate
- 2 CAS Bus Second Level Strength Control**
- 0 Normal slew rate..... default
 - 1 More slew rate
- 1 VC-DRAM**
- 0 Disable..... default
 - 1 Enable
- 0 Multi-Page Open**
- 0 Disable (page registers marked invalid and no page register update which causes non page-mode operation)
 - 1 Enable default

Device 0 Offset 6C - SDRAM Control (00h).....RW

7-5 **Reserved** always reads 0

4 CKE Configuration

- 0 Rx6B[4]=0 RASA = CSA, RASB = CSB,
CKE0=CKE0, CKE1 = CKE1
- x Rx6B[4]=1 RASA = CSA, RASB = Float,
CASB = Float, MAB = Float,
CKE0 = CKE0, CKE1 = CKE0
- 1 Rx6B[4]=0 RASA = CSA, RASB = CSB,
CKE3-2 = CSA7-6
CKE5-4 = CSB7-6
CKE1 = GCKE (Global CKE)
CKE0 = FENA (FET Enable)

3 Fast TLB Lookup

- 0 Disabledefault
- 1 Enable

2-0 SDRAM Operation Mode Select

- 000 Normal SDRAM Modedefault
- 001 NOP Command Enable
- 010 All-Banks-Precharge Command Enable
(CPU-to-DRAM cycles are converted
to All-Banks-Precharge commands).
- 011 MSR Enable
CPU-to-DRAM cycles are converted to
commands and the commands are driven on
MA[14:0]. The BIOS selects an appropriate
host address for each row of memory such that
the right commands are generated on
MA[14:0].
- 100 CBR Cycle Enable (if this code is selected,
CAS-before-RAS refresh is used; if it is not
selected, RAS-Only refresh is used)
- 101 Reserved
- 11x Reserved

Device 0 Offset 6D - DRAM Drive Strength (00h)..... RW

7 **Reserved** always reads 0

6-5 Delay DRAM Read Latch

- 00 No Delay..... default
- 01 0.5 ns
- 10 1.0 ns
- 11 1.5 ns

4 Memory Data Drive (MD, MECC)

- 0 6 mA default
- 1 8 mA

3 SDRAM Command Drive (SRAS#, SCAS#, SWE#)

- 0 16mA default
- 1 24mA

2 Memory Address Drive (MA, WE#)

- 0 16mA default
- 1 24mA

1 CAS# Drive

- 0 8 mA default
- 1 12 mA

0 RAS# Drive

- 0 16mA default
- 1 24mA

Device 0 Offset 6E - ECC Control (00h).....RW

- 7 ECC / ECMode Select**
 - 0 ECC Checking and Reportingdefault
 - 1 ECC Checking, Reporting, and Correcting
- 6 Reserved** always reads 0
- 5 Enable SERR# on ECC / EC Multi-Bit Error**
 - 0 Don't assert SERR# for multi-bit errors..... def
 - 1 Assert SERR# for multi-bit errors
- 4 Enable SERR# on ECC / EC Single-Bit Error**
 - 0 Don't assert SERR# for single-bit errors..... def
 - 1 Assert SERR# for single-bit errors
- 3 ECC / EC Enable - Bank 7/6 (DIMM 3)**
 - 0 Disable (no ECC or EC for banks 7/6)...default
 - 1 Enable (ECC or EC per bit-7)
- 2 ECC / EC Enable - Bank 5/4 (DIMM 2)**
 - 0 Disable (no ECC or EC for banks 5/4)...default
 - 1 Enable (ECC or EC per bit-7)
- 1 ECC / EC Enable - Bank 3/2 (DIMM 1)**
 - 0 Disable (no ECC or EC for banks 3/2)...default
 - 1 Enable (ECC or EC per bit-7)
- 0 ECC / EC Enable - Bank 1/0 (DIMM 0)**
 - 0 Disable (no ECC or EC for banks 1/0)...default
 - 1 Enable (ECC or EC per bit-7)

Device 0 Offset 6F - ECC Status (00h)..... RWC

- 7 Multi-bit Error Detected**..... write of '1' resets
- 6-4 Multi-bit Error DRAM Bank**..... default=0
Encoded value of the bank with the multi-bit error.
- 3 Single-bit Error Detected**..... write of '1' resets
- 2-0 Single-bit Error DRAM Bank** default=0
Encoded value of the bank with the single-bit error.

Error checking / correction may be enabled bank-pair by bank-pair (DIMM by DIMM) by using bits 0-2 above. Bank pairs must be populated with 72-bit memory to enable for EC or ECC since the additional data bits must be present in either case. For this reason, if 64-bit memory is populated in a particular bank pair, the corresponding bit 0-2 should be set to 0 to disable both EC and ECC for that bank pair. For those bank pairs that have 72-bit memory available (and have the corresponding bit 0-2 set), either EC or ECC may be selected via bit-7 above (i.e., all enabled bank pairs will use EC or all will use ECC).

If error checking / reporting only (EC) is selected, all read and write cycles will use normal timing. Partial writes (with EC or ECC enabled) will use read-modify-write cycles to maintain correct error correction codes in the additional 8 data bits. If EC and ECC are disabled for a particular bank pair, partial writes to that bank pair will use the byte enables to write only the selected bytes (using normal write cycles and cycle timing). If error correction (ECC) is selected, the first read of a transaction will always have one additional cycle of latency.

Bit-7 Bits 2-0 RMW Error Checking Error Correction

0/1	0	No	No	No
0	1	Yes	Yes	No
1	1	Yes	Yes	Yes

PCI Bus Control

These registers are normally programmed once at system initialization time.

Device 0 Offset 70 - PCI Buffer Control (00h).....RW

- 7 CPU to PCI Post-Write**
 - 0 Disabledefault
 - 1 Enable
- 6 PCI Master to DRAM Post-Write**
 - 0 Disabledefault
 - 1 Enable
- 5 Reserved** always reads 0
- 4 PCI Master to DRAM Prefetch**
 - 0 Disabledefault
 - 1 Enable
- 3 Enhance CPU-to-PCI Write**
 - 0 Normal operationdefault
 - 1 Reduce 1 cycle when the CPU-to-PCI buffer becomes available after being full (applies to both PCI and AGP buses)
- 2 PCI Master Read Caching**
 - 0 Disabledefault
 - 1 Enable
- 1 Delay Transaction**
 - 0 Disabledefault
 - 1 Enable
- 0 Slave Device Stopped Idle Cycle Reduction**
 - 0 Normal Operation.....default
 - 1 Reduce 1 PCI idle cycle when stopped by a slave device (PCI and AGP buses)

Device 0 Offset 71 - CPU to PCI Flow Control 1 (00h) . RW

- 7 Dynamic Burst**
 - 0 Disable..... default
 - 1 Enable (see note under bit-3 below)
- 6 Byte Merge**
 - 0 Disable..... default
 - 1 Enable
- 5 Reserved** always reads 0
- 4 PCI I/O Cycle Post Write**
 - 0 Disable..... default
 - 1 Enable
- 3 PCI Burst**
 - 0 Disable..... default
 - 1 Enable (bit7=1 will override this option)
- bit-7 bit-3 Operation**
 - 0 0 Every write goes into the write buffer and no PCI burst operations occur.
 - 0 1 If the write transaction is a burst transaction, the information goes into the write buffer and burst transfers are later performed on the PCI bus. If the transaction is not a burst, PCI write occurs immediately (after a write buffer flush).
 - 1 x Every write transaction goes to the write buffer; burstable transactions will then burst on the PCI bus and non-burstable won't. This is the normal setting.
- 2 PCI Fast Back-to-Back Write**
 - 0 Disable..... default
 - 1 Enable
- 1 Quick Frame Generation**
 - 0 Disable..... default
 - 1 Enable
- 0 1 Wait State PCI Cycles**
 - 0 Disable..... default
 - 1 Enable

Device 0 Offset 72 - CPU to PCI Flow Control 2 (00h) RWC

- 7 Retry Status**
 - 0 No retry occurreddefault
 - 1 Retry occurred..... **write 1 to clear**
- 6 Retry Timeout Action**
 - 0 Retry Forever (record status only).....default
 - 1 Flush buffer for write or return all 1s for read
- 5-4 Retry Limit**
 - 00 Retry 2 timesdefault
 - 01 Retry 16 times
 - 10 Retry 4 times
 - 11 Retry 64 times
- 3 Clear Failed Data and Continue Retry**
 - 0 Flush the entire post-write bufferdefault
 - 1 When data is posting and master (or target) abort fails, pop the failed data if any, and keep posting
- 2 CPU Backoff on PCI Read Retry Failure**
 - 0 Disabledefault
 - 1 Backoff CPU when reading data from PCI and retry fails
- 1 Reduce 1T for FRAME# Generation**
 - 0 Disabledefault
 - 1 Enable
- 0 Reduce 1T for CPU read PCI slave**
 - 0 DisableDefault
 - 1 Enable

Device 0 Offset 73 - PCI Master Control 1 (00h)..... RW

- 7 Reserved**always reads 0
- 6 PCI Master 1-Wait-State Write**
 - 0 Zero wait state TRDY# response default
 - 1 One wait state TRDY# response
- 5 PCI Master 1-Wait-State Read**
 - 0 Zero wait state TRDY# response default
 - 1 One wait state TRDY# response
- 4 Disable Prefetch when Delay Transaction Enabled**
 - 0 Disable default
 - 1 Enable
- 3 Assert STOP# after PCI Master Write Timeout**
 - 0 Disable default
 - 1 Enable
- 2 Assert STOP# after PCI Master Read Timeout**
 - 0 Disable default
 - 1 Enable
- 1 LOCK# Function**
 - 0 Disable default
 - 1 Enable
- 0 PCI Master Broken Timer Enable**
 - 0 Disable default
 - 1 Enable. Force into arbitration when there is no FRAME# 16 PCICLK's after the grant.

Device 0 Offset 74 - PCI Master Control 2 (00h)..... RW

- 7 PCI Master Read Prefetch by Enhance Command**
 - 0 Always Prefetch default
 - 1 Prefetch only if Enhance command
- 6 PCI Master Write Merge**
 - 0 Disable default
 - 1 Enable
- 5 Reserved**always reads 0
- 4 Dummy Request**..... default = 0
- 3 PCI Delay Transaction Timeout**
 - 0 Disable default
 - 1 Enable
- 2 Backoff CPU Immediately on CPU-to-AGP**
 - 0 Disable default
 - 1 Enable
- 1-0 CPU/PCI Master Latency Timer Control**
 - 00 AGP master reloads MLT timer default
 - 01 AGP master falling edge reloads MLT timer
 - 10 AGP master rising edge resets timer to 00 and AGP master falling edge reloads MLT timer
 - 11 Reserved (do not program)

Device 0 Offset 75 - PCI Arbitration 1 (00h)RW

- 7 Arbitration Mechanism**
 - 0 PCI has prioritydefault
 - 1 Fair arbitration between PCI and CPU
- 6 Arbitration Mode**
 - 0 REQ-based (arbitrate at end of REQ#)...default
 - 1 Frame-based (arbitrate at FRAME# assertion)
- 5-4 Latency Timer** read only, reads Rx0D bits 2:1
- 3-0 PCI Master Bus Time-Out**
 (force into arbitration after a period of time)
 - 0000 Disabledefault
 - 0001 1x32 PCICLKs
 - 0010 2x32 PCICLKs
 - 0011 3x32 PCICLKs
 - 0100 4x32 PCICLKs
 -
 - 1111 15x32 PCICLKs

Device 0 Offset 76 - PCI Arbitration 2 (00h)..... RW

- 7 CPU-to-PCI Post-Write Retry Failed**
 - 0 Continue retry attempt default
 - 1 Go to arbitration
- 6 CPU Latency Timer Bit-0**RO
 - 0 CPU has at least 1 PCLK time slot when CPU has PCI bus
 - 1 CPU has no time slot
- 5-4 Master Priority Rotation Control**
 - 0x Grant to CPU after every PCI master grant
 default = 00
 - 10 Grant to CPU after every 2 PCI master grants
 - 11 Grant to CPU after every 3 PCI master grants

With setting 01, the CPU will always be granted access after the current bus master completes, no matter how many PCI masters are requesting. With setting 10, if other PCI masters are requesting during the current PCI master grant, the highest priority master will get the bus after the current master completes, but the CPU will be guaranteed to get the bus after that master completes. With setting 11, if other PCI masters are requesting, the highest priority will get the bus next, then the next highest priority will get the bus, then the CPU will get the bus. In other words, with the above settings, even if multiple PCI masters are continuously requesting the bus, the CPU is guaranteed to get access after every master grant (01), after every other master grant (10) or after every third master grant (11).
- 3-2 REQn to REQ4 Mapping**
 - 00 REQ4
 - 01 REQ0
 - 10 REQ1
 - 11 REQ2
- 1 CPU-to-PCI QW High DW Read Access to Allow Backoff of PCI Slave**
 - 0 Disable..... default
 - 1 Enable
- 0 REQ4 is High Priority Master**
 - 0 Disable..... default
 - 1 Enable

Device 0 Offset 77 - Chip Test Mode (00h)..... RW

- 7 Reserved (no function)** always reads 0
- 6-0 Reserved (do not use)** default=0

Device 0 Offset 78 - PMU Control 1 (00h)RW

- 7 **I/O Port 22 Access**
 - 0 CPU access to I/O address 22h is passed on to the PCI busdefault
 - 1 CPU access to I/O address 22h is processed internally
- 6 **Suspend Refresh Type**
 - 0 CBR Refreshdefault
 - 1 Self Refresh
- 5 **Reserved** always reads 0
- 4 **Dynamic Clock Control**
 - 0 Normal (clock is always running).....default
 - 1 Clock to various internal functional blocks is disabled when those blocks are not being used
- 3 **Reserved** always reads 0
- 2 **GSTOP# Assertion**
 - 0 Disable (GSTOP# is always high).....default
 - 1 Enable (GSTOP# could be low)
- 1 **Reserved** always reads 0
- 0 **Memory Clock Enable (CKE) Function**
 - 0 CKE Function Disable.....default
 - 1 CKE Function Enable

Device 0 Offset 79 - PMU Control 2 (00h)RW

- 7 **KCTL module CLOCK dynamic stop enable**
 - 0 Disabledefault
 - 1 Enable
- 6 **DRAMC module CLOCK dynamic stop enable**
 - 0 Disabledefault
 - 1 Enable
- 5 **AGPC module CLOCK dynamic stop enable**
 - 0 Disabledefault
 - 1 Enable
- 4 **PCIC module CLOCK dynamic stop enable**
 - 0 Disabledefault
 - 1 Enable
- 3 **Pseudo Power Good enable**
 - 0 Disabledefault
 - 1 Enable
- 2 **Indicate SIO's request to DRAM controller**
 - 0 Disabledefault
 - 1 Enable
- 1-0 **Reserved** always reads 0

Device 0 Offset 7A – Miscellaneous Control RW

- 7 **No Time-Out Arbitration for Consecutive Frame Accesses**
 - 0 Enable default
 - 1 Disable
- 6-4 **Reserved** always reads 0
- 3 **Background PCI-to-PCI Write Cycle Mode**
 - 0 Enable default
 - 1 Disable
- 2-1 **Reserved** always reads 0
- 0 **South Bridge PCI Master Force Timeout When PCI Master Occupancy Timer Is Up**
 - 0 Disable..... default
 - 1 Enable

Device 0 Offset 7E – PLL Test Mode (00h) RW

- 7-6 **Reserved (status)**RO
- 5-0 **Reserved (do not use)** default=0

Device 0 Offset 7F – PLL Test Mode (00h) RW

- 7-0 **Reserved (do not use)** default=0

GART / Graphics Aperture Control

The function of the Graphics Address Relocation Table (GART) is to translate virtual 32-bit addresses issued by an AGP device into 4K-page based physical addresses for system memory access. In this translation, the upper 20 bits (A31-A12) are remapped, while the lower 12 address bits (A11-A0) are used unchanged.

A one-level fully associative lookup scheme is used to implement the address translation. In this scheme, the upper 20 bits of the virtual address are used to point to an entry in a page table located in system memory. Each page table entry contains the upper 20 bits of a physical address (a "physical page" address). For simplicity, each page table entry is 4 bytes. The total size of the page table depends on the GART range (called the "aperture size") which is programmable in the VT82C693A.

This scheme is shown in the figure below.

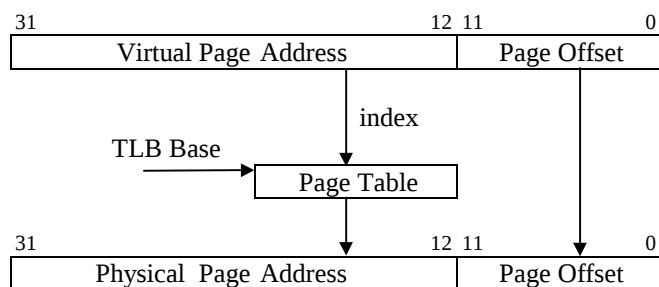


Figure 5. Graphics Aperture Address Translation

Since address translation using the above scheme requires an access to system memory, an on-chip cache (called a "Translation Lookaside Buffer" or TLB) is utilized to enhance performance. The TLB in the VT82C693A contains 16 entries. Address "misses" in the TLB require an access of system memory to retrieve translation data. Entries in the TLB are replaced using an LRU (Least Recently Used) algorithm.

Addresses are translated only for accesses within the "Graphics Aperture" (GA). The Graphics Aperture can be any power of two in size from 1MB to 256MB (i.e., 1MB, 2MB, 4MB, 8MB, etc). The base of the Graphics Aperture can be anywhere in the system virtual address space on an address boundary determined by the aperture size (e.g., if the aperture size is 4MB, the base must be on a 4MB address boundary). The Graphics Aperture Base is defined in register offset 10 of device 0. The Graphics Aperture Size and TLB Table Base are defined in the following register group (offsets 84 and 88 respectively) along with various control bits.

Device 0 Offset 83-80 - GART/TLB Control (00000000h) RW

- 31-16 **Reserved** always reads 0
- 15-8 **Reserved (test mode status)**..... RO
- 7 **Flush Page TLB**
- 0 Disabledefault
- 1 Enable
- 6-4 **Reserved (always program to 0)** RW
- 3 **PCI Master Address Translation for GA Access**
- 0 Addresses generated by PCI Master accesses of the Graphics Aperture will not be translateddefault
- 1 PCI Master GA addresses will be translated
- 2 **AGP Master Address Translation for GA Access**
- 0 Addresses generated by AGP Master accesses of the Graphics Aperture will not be translateddefault
- 1 AGP Master GA addresses will be translated
- 1 **CPU Address Translation for GA Access**
- 0 Addresses generated by CPU accesses of the Graphics Aperture will not be translated..... def
- 1 CPU GA addresses will be translated
- 0 **AGP Address Translation for GA Access**
- 0 Addresses generated by AGP accesses of the Graphics Aperture will not be translated..... def
- 1 AGP GA addresses will be translated

Note: For any master access to the Graphics Aperture range, snoop will not be performed.

Device 0 Offset 84 - Graphics Aperture Size (00h) RW
7-0 Graphics Aperture Size

- 11111111 1M
- 11111110 2M
- 11111100 4M
- 11111000 8M
- 11110000 16M
- 11100000 32M
- 11000000 64M
- 10000000 128M
- 00000000 256M

Offset 8B-88 - GA Translation Table Base (00000000h) RW
31-12 Graphics Aperture Translation Table Base.

Pointer to the base of the translation table in system memory used to map addresses in the aperture range (the pointer to the base of the "Directory" table).

11-3 Reservedalways reads 0

2 PCI Master Directly Accesses DRAM if in GART Range

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

1 Graphics Aperture Enable

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

Note: To disable the Graphics Aperture, set this bit to 0 and set all bits of the Graphics Aperture Size to 0. To enable the Graphics Aperture, set this bit to 1 and program the Graphics Aperture Size to the desired aperture size.

0 Reservedalways reads 0

AGP Control

Device 0 Offset A3-A0 - AGP Capability Identifier

(000100002h)RO

- 31-24 Reserved** always reads 00
- 23-20 Major Specification Revision** always reads 0001
Major revision # of AGP spec device conforms to
- 19-16 Minor Specification Revision** always reads 0000
Minor revision # of AGP spec device conforms to
- 15-8 Pointer to Next Item**..... always reads 00 (last item)
- 7-0 AGP ID** .. (always reads 02 to indicate it is AGP)

Device 0 Offset A7-A4 - AGP Status (07000203h).....RO

- 31-24 Maximum AGP Requests** always reads 07†
Max # of AGP requests the device can manage (8)
(†see RxFC[1] and RxFD[2-0] for optional modification of readback value)
- 23-10 Reserved**always reads 0s
- 9 Supports SideBand Addressing** always reads 1
- 8-2 Reserved**always reads 0s
- 1 2X Rate Supported**
Value returned can be programmed by writing to RxAC[3]
- 0 1X Rate Supported**..... always reads 1

Device 0 Offset AB-A8 - AGP Command (00000000h) . RW

- 31-24 Request Depth** (reserved for target) .. always reads 0s
- 23-10 Reserved** always reads 0s
- 9 SideBand Addressing Enable**
 - 0 Disable..... default
 - 1 Enable
- 8 AGP Enable**
 - 0 Disable..... default
 - 1 Enable
- 7-2 Reserved** always reads 0s
- 1 2X Mode Enable**
 - 0 Disable..... default
 - 1 Enable
- 0 1X Mode Enable**
 - 0 Disable..... default
 - 1 Enable

Device 0 Offset AC - AGP Control (08h)RW

- 7 **AGP Disable** RO
 - 0 Disabledefault
 - 1 Enable

This bit is latched from MAB9# at the rising edge of RESET#.
- 6 **AGP Read Synchronization**
 - 0 Disabledefault
 - 1 Enable
- 5 **AGP Read Snoop DRAM Post-Write Buffer**
 - 0 Disabledefault
 - 1 Enable
- 4 **GREQ# Priority Becomes Higher When Arbiter is Parked at AGP Master**
 - 0 Disabledefault
 - 1 Enable
- 3 **2X Rate Supported** (read also at RxA4[1])
 - 0 Not supported
 - 1 Supporteddefault
- 2 **LPR In-Order Access (Force Fence)**
 - 0 Fence/Flush functions not guaranteed. AGP read requests (low/normal priority and high priority) may be executed before previously issued write requests.....default
 - 1 Force all requests to be executed in order (automatically enables Fence/Flush functions). Low (i.e., normal) priority AGP read requests will never be executed before previously issued writes. High priority AGP read requests may still be executed prior to previously issued write requests as required.
- 1 **AGP Arbitration Parking**
 - 0 Disabledefault
 - 1 Enable (GGNT# remains asserted until either GREQ# de-asserts or data phase ready)
- 0 **Arbitration Priority Between CPU-to-PCI Post Write and PCI Master Request After PCI Master Access**
 - 0 CPU-to-PCI write buffer has prioritydefault
 - 1 PCI master has priority

Device 0 Offset AD - AGP Latency Timer.....RW

- 7-5 **Reserved** always reads 0
- 4 **Choose First or Last ready of DRAM**
 - 0 Last ready chosendefault
 - 1 First ready chosen
- 3-0 **AGP Data Phase Latency Timer**..... default = 02h

Device 0 Offset F7-F0 - BIOS Scratch Registers RW

- 7-0 **No hardware function** default = 0

Device 0 Offset F8 - DRAM Arbitration Timer (00h)... RW

- 7-4 **AGP Timer** default = 0
- 3-0 **Host CPU Timer** default = 0

Device 0 Offset FC - Back-Door Control 1 (00h) RW

- 7-4 **Priority Timer**..... default = 0
- 3-2 **Reserved (Do Not Program)** default = 0
- 1 **Back-Door Max # of AGP Requests**..... default = 0
 - 0 Read of RxA7 always returns a value of 7....def
 - 1 Read of RxA7 returns the value programmed in RxFD[2-0]
- 0 **Back-Door Device ID Enable**..... default = 0
 - 0 Use Rx3-2 value for Rx3-2 readback..... default
 - 1 Use RxFE-FF Back-Door Device ID for Rx3-2 read

Device 0 Offset FD - Back-Door Control 2 (00h) RW

- 7-3 **Reserved** always reads 0
- 2-0 **Max # of AGP Requests** default = 0
(see also RxA7 and RxFC[1])

Device 0 Offset FF-FE - Back-Door Device ID (0000h) RW

- 15-0 **Back-Door Device ID**..... default = 0

Device 1 Header Registers - PCI-to-PCI Bridge

All registers are located in PCI configuration space. They should be programmed using PCI configuration mechanism 1 through CF8 / CFC with bus number of 0 and function number equal to 0 and device number equal to one.

Device 1 Offset 1-0 - Vendor ID (1106h)RO

15-0 **ID Code** (reads 1106h to identify VIA Technologies)

Device 1 Offset 3-2 - Device ID (8698h)RO

15-0 **ID Code** (reads 8698h to identify the VT82C693A PCI-to-PCI Bridge device)

Device 1 Offset 5-4 - Command (0007h)RW

15-10 **Reserved** always reads 0

9 **Fast Back-to-Back Cycle Enable** RO

0 Fast back-to-back transactions only allowed to the same agentdefault

1 Fast back-to-back transactions allowed to different agents

8 **SERR# Enable** RO

0 SERR# driver disableddefault

1 SERR# driver enabled

(SERR# is used to report parity errors if bit-6 is set).

7 **Address / Data Stepping** RO

0 Device never does steppingdefault

1 Device always does stepping

6 **Parity Error Response**RW

0 Ignore parity errors & continuedefault

1 Take normal action on detected parity errors

5 **VGA Palette Snoop (Not Supported)** RO

0 Treat palette accesses normallydefault

1 Don't respond to palette writes on PCI bus (10-bit decode of I/O addresses 3C6-3C9 hex)

4 **Memory Write and Invalidate Command** RO

0 Bus masters must use Mem Writedefault

1 Bus masters may generate Mem Write & Inval

3 **Special Cycle Monitoring** RO

0 Does not monitor special cyclesdefault

1 Monitors special cycles

2 **Bus Master**RW

0 Never behaves as a bus master

1 Enable to operate as a bus master on the primary interface on behalf of a master on the secondary interfacedefault

1 **Memory Space**RW

0 Does not respond to memory space

1 Enable memory space accessdefault

0 **I/O Space**RW

0 Does not respond to I/O space

1 Enable I/O space accessdefault

Device 1 Offset 7-6 - Status (Primary Bus) (0220h) RWC

15 **Detected Parity Error** always reads 0

14 **Signaled System Error (SERR#)** always reads 0

13 **Signaled Master Abort**

0 No abort received default

1 Transaction aborted by the master with Master-Abort (except Special Cycles) write 1 to clear

12 **Received Target Abort**

0 No abort received default

1 Transaction aborted by the target with Target-Abort write 1 to clear

11 **Signaled Target Abort** always reads 0

10-9 **DEVSEL# Timing**

00 Fast

01 Medium always reads 01

10 Slow

11 Reserved

8 **Data Parity Error Detected** always reads 0

7 **Fast Back-to-Back Capable** always reads 0

6 **User Definable Features** always reads 0

5 **66MHz Capable** always reads 1

4 **Supports New Capability list** always reads 0

3-0 **Reserved** always reads 0

Device 1 Offset 8 - Revision ID (00h) RO

7-0 **VT82C693A Chip Revision Code** (00=First Silicon)

Device 1 Offset 9 - Programming Interface (00h) RO

This register is defined in different ways for each Base/Sub-Class Code value and is undefined for this type of device.

7-0 **Interface Identifier** always reads 00

Device 1 Offset A - Sub Class Code (04h) RO

7-0 **Sub Class Code** ..reads 04 to indicate PCI-PCI Bridge

Device 1 Offset B - Base Class Code (06h) RO

7-0 **Base Class Code** ..reads 06 to indicate Bridge Device

Device 1 Offset D - Latency Timer (00h) RO

7-0 **Reserved** always reads 0

Device 1 Offset E - Header Type (01h) RO

7-0 **Header Type Code** reads 01: PCI-PCI Bridge

Device 1 Offset F - Built In Self Test (BIST) (00h) RO

7 **BIST Supported** reads 0: no supported functions

6 **Start Test** write 1 to start but writes ignored

5-4 **Reserved** always reads 0

3-0 **Response Code** 0 = test completed successfully

Device 1 Offset 18 - Primary Bus Number (00h).....RW

7-0 Primary Bus Number..... default = 0

This register is read write, but internally the chip always uses bus 0 as the primary.

Device 1 Offset 19 - Secondary Bus Number (00h).....RW

7-0 Secondary Bus Number..... default = 0

Note: AGP must use these bits to convert Type 1 to Type 0.

Device 1 Offset 1A - Subordinate Bus Number (00h).....RW

7-0 Primary Bus Number..... default = 0

Note: AGP must use these bits to decide if Type 1 to Type 1 command passing is allowed.

Device 1 Offset 1B - Secondary Latency Timer (00h).....RO

7-0 Reserved always reads 0

Device 1 Offset 1C - I/O Base (F0h).....RW

7-4 I/O Base AD[15:12]..... default = 1111b

3-0 I/O Addressing Capability..... default = 0

Device 1 Offset 1D - I/O Limit (00h).....RW

7-4 I/O Limit AD[15:12] default = 0

3-0 I/O Addressing Capability..... default = 0

Device 1 Offset 1F-1E - Secondary Status (0000h).....RO

15-0 Reserved always reads 0000

Device 1 Offset 21-20 - Memory Base (FFF0h).....RW

15-4 Memory Base AD[31:20] default = FFFh

3-0 Reserved always reads 0

Device 1 Offset 23-22 - Memory Limit (Inclusive) (0000h) RW

15-4 Memory Limit AD[31:20]..... default = 0

3-0 Reserved always reads 0

Device 1 Offset 25-24 - Prefetchable Memory Base (fff0h) RW

15-4 Prefetchable Memory Base AD[31:20]...def = FFFh

3-0 Reserved always reads 0

Device 1 Offset 27-26 - Prefetchable Memory Limit (0000h).....RW

15-4 Prefetchable Memory Limit AD[31:20] def = 0

3-0 Reserved always reads 0

Device 1 Offset 3F-3E – PCI-to-PCI Bridge Control (0000h) RW

15-4 Reserved always reads 0

3 **VGA-Present on AGP**

0 Forward VGA accesses to PCI Bus #1 .. default

1 Forward VGA accesses to PCI Bus #2 / AGP

Note: VGA addresses are memory A0000-BFFFFh and I/O addresses 3B0-3BBh, 3C0-3CFh and 3D0-3DFh (10-bit decode). "Mono" text mode uses B0000-B7FFFh and "Color" Text Mode uses B8000-BFFFFh. Graphics modes use Axxxxh. Mono VGA uses I/O addresses 3Bx-3Cxh and Color VGA uses 3Cx-3Dxh. If an MDA is present, a VGA will not use the 3Bxh I/O addresses and B0000-B7FFFh memory space; if not, the VGA will use those addresses to emulate MDA modes.

2 **Block / Forward ISA I/O Addresses**

0 Forward all I/O accesses to the AGP bus if they are in the range defined by the I/O Base and I/O Limit registers (device 1 offset 1C-1D)

..... default

1 Do not forward I/O accesses to the AGP bus that are in the 100-3FFh address range even if they are in the range defined by the I/O Base and I/O Limit registers.

1-0 Reserved always reads 0

Device 1 Configuration Registers - PCI-to-PCI Bridge

AGP Bus Control

Device 1 Offset 40 - CPU-to-AGP Flow Control 1 (00h)RW

- 7 **CPU-to-AGP Post Write**
 - 0 Disabledefault
 - 1 Enable
- 6 **CPU-to-AGP Dynamic Burst**
 - 0 Disabledefault
 - 1 Enable
- 5 **CPU-to-AGP One Wait State Burst Write**
 - 0 Disabledefault
 - 1 Enable
- 4 **AGP to DRAM Prefetch**
 - 0 Disabledefault
 - 1 Enable
- 3 **CPU to AGP Posting Write**
 - 0 Disabledefault
 - 1 Enable
- 2 **MDA Present on AGP**
 - 0 Forward MDA accesses to AGP.....default
 - 1 Forward MDA accesses to PCI

Note: Forward despite IO / Memory Base / Limit

Note: MDA (Monochrome Display Adapter) addresses are memory addresses B0000h-B7FFFh and I/O addresses 3B4-3B5h, 3B8-3BAh, and 3BFh (10-bit decode). 3BC-3BE are reserved for printers.

Note: If Rx3E bit-3 is 0, this bit is a don't care (MDA accesses are forwarded to the PCI bus).
- 1 **AGP Master Read Caching**
 - 0 Disabledefault
 - 1 Enable
- 0 **AGP Delay Transaction**
 - 0 Disabledefault
 - 1 Enable

Table 6. VGA/MDA Memory/IO Redirection

<u>3E[3]</u> <u>VGA</u> <u>Pres.</u>	<u>40[2]</u> <u>MDA</u> <u>Pres.</u>	<u>VGA</u> <u>is</u> <u>on</u>	<u>MDA</u> <u>is</u> <u>on</u>	<u>Axxxx</u> <u>B8xxx</u> <u>Access</u>	<u>B0000</u> <u>-B7FFF</u> <u>Access</u>	<u>3Cx</u> <u>3Dx</u> <u>I/O</u>	<u>3Bx</u> <u>I/O</u>
0	-	PCI	PCI	PCI	PCI	PCI	PCI
1	0	AGP	AGP	AGP	AGP	AGP	AGP
1	1	AGP	PCI	AGP	PCI	AGP	PCI

Device 1 Offset 41 - CPU-to-AGP Flow Control 2 (00h) RW

- 7 **Retry Status**
 - 0 No retry occurred..... default
 - 1 Retry Occurred**write 1 to clear**
- 6 **Retry Timeout Action**
 - 0 No action taken except to record status def
 - 1 Flush buffer for write or return all 1s for read
- 5-4 **Retry Count**
 - 00 Retry 2, backoff CPU default
 - 01 Retry 4, backoff CPU
 - 10 Retry 16, backoff CPU
 - 11 Retry 64, backoff CPU
- 3 **Post Write Data on Abort**
 - 0 Flush entire post-write buffer on target-abort or master abort..... default
 - 1 Pop one data output on target-abort or master-abort
- 2 **CPU Backoff on AGP Read Retry Timeout**
 - 0 Disable..... default
 - 1 Enable
- 1-0 **Reserved**always reads 0

Device 1 Offset 42 - AGP Master Control (00h) RW

- 7 **Read Prefetch for Enhance Command**
 - 0 Always Perform Prefetch..... default
 - 1 Prefetch only if Enhance Command
- 6 **AGP Master One Wait State Write**
 - 0 Disable..... default
 - 1 Enable
- 5 **AGP Master One Wait State Read**
 - 0 Disable..... default
 - 1 Enable
- 4 **Extend AGP Internal Master for Efficient Handling of Dummy Request Cycles**
 - 0 Disable..... default
 - 1 Enable

This bit is normally set to 1.
- 3 **AGP Delay Transaction Timeout**
 - 0 Disable..... default
 - 1 Enable
- 2 **Prefetch Disable When Delay Transaction Occurs**
 - 0 Normal operation..... default
 - 1 Disable prefetch when doing fast response to the previous delay transaction or doing read caching
- 1 **Reserved**always reads 0
- 0 **Reserved (do not use)** default = 0

Device 1 Offset 43 - AGP Master Latency Timer (00h) RW

- 7-4 CPU to AGP Time slot**
- 0 Disable (no timer).....default
 - 1 16 GCLKs
 - 2 32 GCLKs
 -
 - F 128 GCLKs
- 3-0 AGP master Time slot**
- 0 Disable (no timer).....default
 - 1 16 GCLKs
 - 2 32 GCLKs
 -
 - F 128 GCLKs

Device 1 Offset 44 – Backdoor Device ID Control (00h)RW

- 7-1 Reserved**
- 0 Back Door Device ID**
- 0 Disabledefault
 - 1 Enable

Device 1 Offset 47-46 – Device ID (0000h)RW

- 15-0 PCI-to-PCI Bridge Device ID..... default = 0**

Device 1 Offset 80 – Capability ID (01h) RO

- 7-0 Capability ID always reads 01h**

Device 1 Offset 81 – Next Pointer (00h)..... RO

- 7-0 Next Pointer: Null..... always reads 00h**

Device 1 Offset 82 – Power Mgmt Capabilities 1 (02h).. RO

- 7-0 Power Mgmt Capabilities always reads 02h**

Device 1 Offset 83 – Power Mgmt Capabilities 2 (00h).. RO

- 7-0 Power Mgmt Capabilities always reads 00h**

Device 1 Offset 84 – Power Mgmt Ctrl/Status (00h)..... RW

- 7-2 Reserved always reads 0**
- 1-0 Power State**
- 00 D0 default
 - 01 -reserved-
 - 10 -reserved-
 - 11 D3 Hot

Device 1 Offset 85 – Power Mgmt Status (00h)..... RO

- 7-0 Power Mgmt Status default = 00**

Device 1 Offset 86 – P2P Br. Support Extensions (00h) . RO

- 7-0 P2P Bridge Support Extensions..... default = 00**

Device 1 Offset 87 – Power Management Data (00h)..... RO

- 7-0 Power Management Data..... default = 00**

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Min	Max	Unit
Ambient operating temperature	0	70	°C
Storage temperature	-55	125	°C
Input voltage	-0.5	5.5	Volts
Output voltage ($V_{CC} = 3.1 - 3.6V$)	-0.5	$V_{CC} + 0.5$	Volts

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

TA=0-70°C, $V_{CC}=5V \pm 5\%$, GND=0V

Symbol	Parameter	Min	Max	Unit	Condition
V_{IL}	Input low voltage	-0.50	0.8	V	
V_{IH}	Input high voltage	2.0	$V_{CC}+0.5$	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	μA	$0 < V_{IN} < V_{CC}$
I_{OZ}	Tristate leakage current	-	± 20	μA	$0.45 < V_{OUT} < V_{CC}$
I_{CC}	Power supply current	-		mA	

AC Timing Specifications

AC timing specifications provided are based on external zero-pf capacitance load. Min/max cases are based on the following table:

Table 7. AC Timing Min / Max Conditions

Parameter	Min	Max	Unit
3.3V Power (V_{CC} , V_{CCI} , V_{TT} , AV_{CC} , HV_{CC})	3.135	3.465	Volts
5V Reference (5VREF)	4.75	5.25	Volts
Temperature	0	70	°C

Drive strength for each output pin is programmable. See Rx6D for details.

Table 8. AC Characteristics – Host CPU Interface Timing

Symbol	Setup and Hold	Setup	Hold	Unit	Comment
T _{HDS} / T _{HDH}	HD[63:0]# Bus	1.5	0.5	ns	85 Degrees F.
T _{HAS} / T _{HAH}	HA[31:3]# Bus	1.5	0.5	ns	85 Degrees F.
T _{ADS} / T _{ADH}	ADS#	1.5	0.5	ns	85 Degrees F.
T _{DBS} / T _{DBH}	DBSY#	1.5	0.5	ns	85 Degrees F.
T _{DRS} / T _{DRH}	DRDY#	1.5	0.5	ns	85 Degrees F.
T _{HIS} / T _{HIH}	HIT#	1.5	0.5	ns	85 Degrees F.
T _{HMS} / T _{HMH}	HITM#	1.5	0.5	ns	85 Degrees F.
T _{HLS} / T _{HLH}	HLOCK#	1.5	0.5	ns	85 Degrees F.
T _{HRS} / T _{HRH}	HREQ[4:0]# Bus	1.5	0.5	ns	85 Degrees F.
Symbol	Min / Max Delay	Min	Max	Unit	Comment
T _{HDN} / T _{HDX}	HD[63:0]# Bus	1.4	4.10	ns	85 Degrees F.
T _{HAN} / T _{HAX}	HA[31:3]# Bus	1.4	3.90	ns	85 Degrees F.
T _{ADN} / T _{ADX}	ADS#	1.4	3.85	ns	85 Degrees F.
T _{DBN} / T _{DBX}	DBSY#	1.4	3.85	ns	85 Degrees F.
T _{DRN} / T _{DRX}	DRDY#	1.4	3.85	ns	85 Degrees F.
T _{HIN} / T _{HIX}	HIT#	1.4	3.85	ns	85 Degrees F.
T _{HMN} / T _{HMX}	HITM#	1.4	3.85	ns	85 Degrees F.
T _{HRN} / T _{HRX}	HREQ[4:0]# Bus	1.4	3.85	ns	85 Degrees F.
T _{BNN} / T _{BNX}	BNR#	1.4	3.85	ns	85 Degrees F.
T _{DEN} / T _{DEX}	DEFER#	1.4	3.85	ns	85 Degrees F.
T _{HTN} / T _{HTX}	HTRDY#	1.4	3.85	ns	85 Degrees F.
T _{RSN} / T _{RSX}	RS[2:0]# Bus	1.4	3.85	ns	85 Degrees F.
T _{BPN} / T _{BPX}	BPRI#	1.4	3.85	ns	85 Degrees F.
T _{BRN} / T _{BRX}	BREQ0#	1.4	3.85	ns	85 Degrees F.
T _{CPN} / T _{CPX}	CPURST#	1.4	3.85	ns	85 Degrees F.
T _{CDN} / T _{CDX}	CPURSTD#	1.4	3.85	ns	85 Degrees F.

Table 9. AC Characteristics – SDRAM Timing

Symbol	Setup and Hold	Setup	Hold	Unit	Comment
T _{MDS} / T _{MDH}	MD Bus	0.5	1.5	ns	85 Degrees F.
T _{MECCS} / T _{MECCH}	MECC Bus	0.5	1.5	ns	85 Degrees F.
Symbol	Min / Max Delay	Min	Max	Unit	Comment
T _{MDN} / T _{MDX}	MD Bus	0.6	3.8	ns	85 Degrees F.
T _{MEN} / T _{MEX}	MECC Bus	0.6	3.8	ns	85 Degrees F.
T _{MAN} / T _{MAX}	MAA Bus	1.4	4.5	ns	85 Degrees F.
T _{MBN} / T _{MBX}	MAB Bus	1.4	4.5	ns	85 Degrees F.
T _{TRAN} / T _{TRAX}	RASA Bus	0.0	4.2	ns	85 Degrees F.
T _{TRBN} / T _{TRBX}	RASB Bus	0.0	4.2	ns	85 Degrees F.
T _{CAN} / T _{CAX}	CASA Bus	0.8	4.2	ns	85 Degrees F.
T _{CBN} / T _{CBX}	CASB Bus	0.8	4.2	ns	85 Degrees F.
T _{SWN} / T _{SWX}	SWE Bus	0.0	4.2	ns	85 Degrees F.
T _{SCN} / T _{SCX}	SCAS Bus	0.8	4.2	ns	85 Degrees F.
T _{SRN} / T _{SRX}	SRAS Bus	0.0	4.2	ns	85 Degrees F.

MECHANICAL SPECIFICATIONS

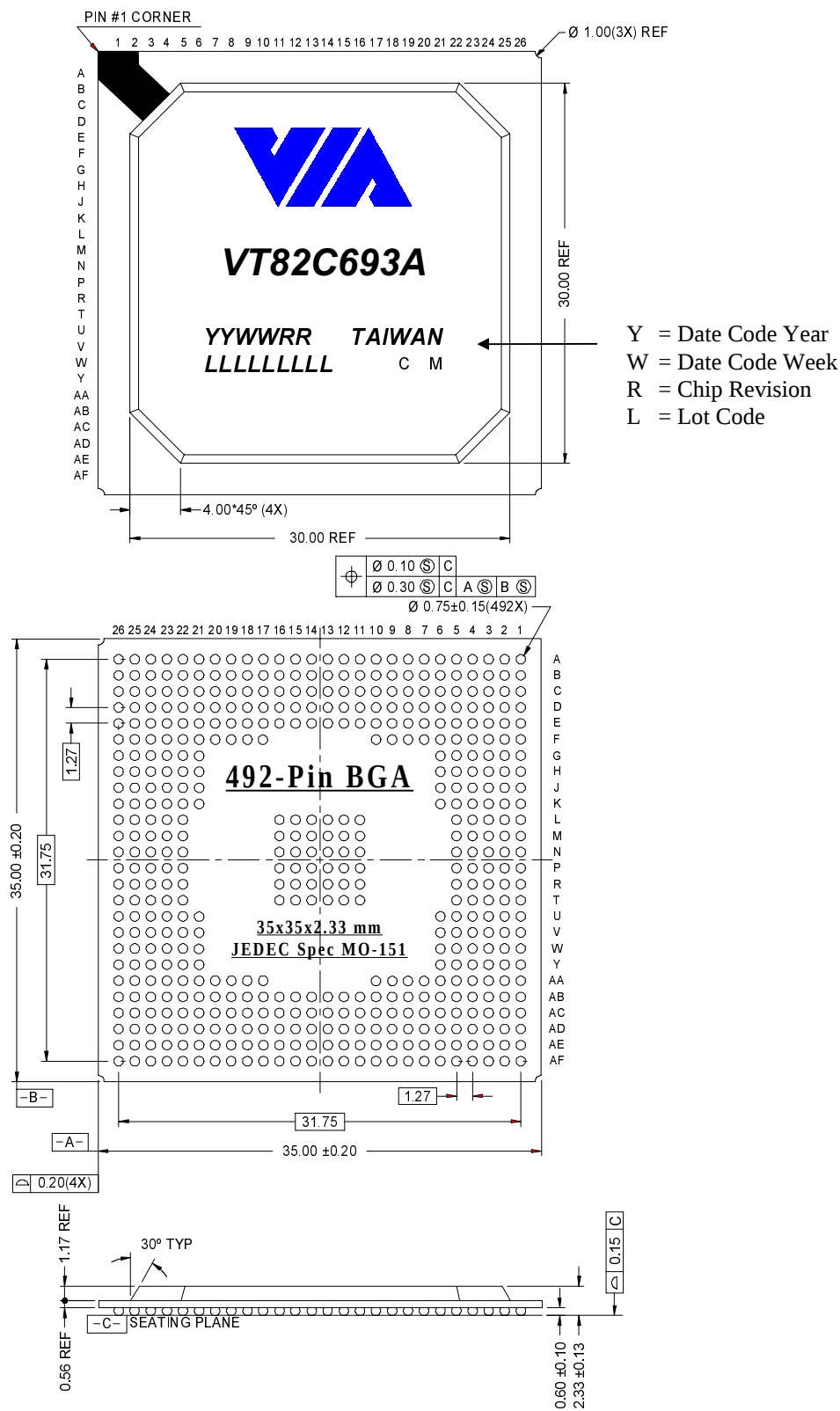


Figure 6. Mechanical Specifications - 492-Pin Ball Grid Array Package