

PCI1451A GJG
PC Card Controller

Data Manual

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1 Introduction

1.1 Description

The Texas Instruments PCI1451A device is a high-performance PC Card controller with a 32-bit PCI interface. The device supports two independent PC Card sockets compliant with the *PC Card Standard* and the *PCI Bus Interface Specification for PCI-to-CardBus Bridges*. The PCI1451A device provides features which make it the best choice for bridging between PCI and PC Cards in both notebook and desktop computers. The *1995 and PC Card™ Standards* retain the 16-bit PC Card specification defined in PCMCIA Release 2.1, and define the new 32-bit PC Card, CardBus, as being capable of full 32-bit data transfers at 33 MHz. The PCI1451A device supports any combination of 16-bit and CardBus PC Cards in the two sockets, powered at 5 Vdc or 3.3 Vdc as required.

The PCI1451A device is compliant with the latest *PCI Bus Power Management Interface Specification*. It also is compliant with the *PCI Local Bus Specification*, and its PCI interface can act as either a PCI master device or a PCI slave device. The PCI bus mastering is initiated during 16-bit PC Card DMA transfers or CardBus PC Card bridging transactions.

All card signals are buffered internally to allow hot insertion and removal. The PCI1451A device is register compatible with the Intel 82365SL-DF ExCA controller. The PCI1451A internal data-path logic allows the host to access 8-, 16-, and 32-bit cards using full 32-bit PCI cycles for maximum performance. Independent buffering and a pipeline architecture provide an unsurpassed performance level with sustained bursting. The PCI1451A device also can be programmed to accept fast-posted writes to improve system-bus utilization.

The PCI1451A device provides an internally buffered zoomed-video (ZV) path. This reduces the design effort of PC board manufacturers to add a ZV compatible solution and ensures compliance with the CardBus loading specifications. Multiple system interrupt signaling options are provided: Serial ISA/Serial PCI, Serial ISA/Parallel PCI, Parallel ISA/Parallel PCI, and PCI-only interrupts. Furthermore, general-purpose inputs and outputs (GPIOs) are provided for the board designer to implement sideband functions. Many other features designed into the PCI1451A device, such as socket-activity light-emitting diode (LED) outputs, are discussed in detail throughout the design specification.

An advanced complementary metal-oxide semiconductor (CMOS) process achieves low system power consumption, while operating at PCI clock rates up to 33 MHz. Several low-power modes allow the host power management system to further reduce power consumption.

Unused PCI1451A inputs must be pulled up using a 43-k Ω resistor.

1.2 Features

The PCI1451A device supports the following features:

- Ultrazoomed video
- Zoomed-video auto-detect
- Advanced filtering on card-detect lines provide 90 microseconds of noise immunity.
- Programmable D3 status pin
- Internal ring oscillator
- 3.3-V core logic with universal PCI interfaces compatible with 3.3-V and 5-V PCI signaling environments
- Mix-and-match 5-V/3.3-V PC Card16 cards and 3.3-V CardBus cards
- Two PC Card or CardBus slots with hot insertion and removal

- Serial interface to TI™ TPS2206 dual power switch
- 132 Mbyte/s burst transfers to maximize data throughput on both the PCI bus and the CardBus bus
- Serialized IRQ with PCI interrupts
- Eight programmable multifunction pins
- Interrupt modes supported: serial ISA/serial PCI, serial ISA/parallel PCI, parallel PCI only
- Serial EEPROM interface for loading subsystem ID and subsystem vendor ID
- Zoomed video with internal buffering
- Dedicated pin for PCI $\overline{\text{CLKRUN}}$
- Four general-purpose event registers
- Multifunction PCI device with separate configuration space for each socket
- Five PCI memory windows and two I/O windows available to each PC Card16 socket
- Two I/O windows and two memory windows available to each CardBus socket
- ExCA™-compatible registers are mapped in memory or I/O space
- Distributed DMA and PC/PCI DMA
- Intel™ 82365SL-DF register compatible
- 16-bit DMA on both PC Card sockets
- Ring indicate, $\overline{\text{SUSPEND}}$, and PCI $\overline{\text{CLKRUN}}$
- Advanced submicron, low-power CMOS technology
- Provides VGA/palette memory and I/O, and subtractive decoding options
- Socket-activity LED pins
- PCI bus lock ($\overline{\text{LOCK}}$)
- Packaged in a 257-pin MicroStar BGA™ package

1.3 Related Documents

- *Advanced Configuration and Power Interface (ACPI) Specification*
- *PC 98/99*
- *PC Card Standard Release 7*
- *PCI Bus Power Management Interface Specification (Revision 1.1)*
- *PCI Local Bus Specification (Revision 2.2)*
- *PCI Bus Interface Specification for PCI-to-CardBus Bridges*
- *PCI Bus Power Management Interface Specification for PCI to CardBus Bridges (Revision 0.6)*
- *PCI Mobile Design Guide*

1.4 Trademarks

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1.5 Ordering Information

ORDERING NUMBER	NAME	VOLTAGE	PACKAGE
PCI1451A	PC Card Controller	3.3 V, 5-V tolerant I/Os	257-ball MicroStar BGA™

2 Terminal Descriptions

The PCI1451A device is packaged in a 257-ball MicroStar BGA™ package. Figure 2–1 is a terminal diagram for the GJG package.

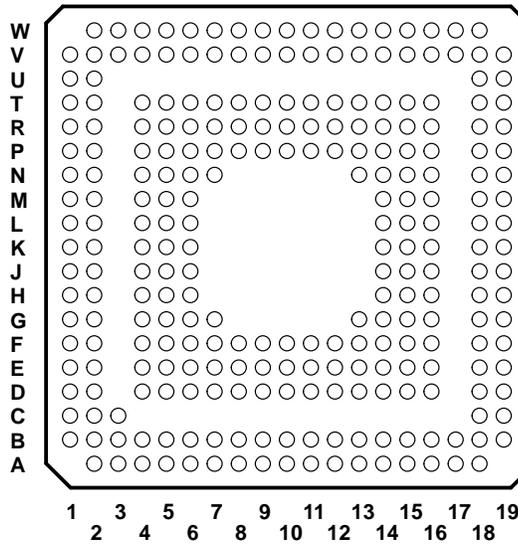


Figure 2–1. PCI1451A GJG Terminal Diagram

Table 2–1 shows the GJG terminal assignments for the CardBus and 16-bit PC Card signal names.

Table 2–2 shows the CardBus PC Card signal names, sorted alphanumerically to the GJG terminal number.

Table 2–3 shows the 16-bit PC Card signal names, sorted alphanumerically to the GJG terminal number.

Table 2–1. GJG Terminals Sorted Alphanumerically for CardBus // 16-Bit Signals

TERM. NO.	SIGNAL NAME		TERM. NO.	SIGNAL NAME		TERM. NO.	SIGNAL NAME	
	CARDBUS	16-BIT		CARDBUS	16-BIT		CARDBUS	16-BIT
A2	A_CC/BE1	A_ADDR8	D5	A_CAD13	A_IORD	F14	B_CAD15	B_IOWR
A3	GND	GND	D6	A_CC/BE0	A_CE1	F15	B_CAD12	B_ADDR11
A4	A_CAD12	A_ADDR11	D7	A_CAD5	A_DATA6	F16	B_CAD13	B_IORD
A5	A_CAD10	A_CE2	D8	GND	GND	F18	VCCB	VCCB
A6	A_CAD8	A_DATA15	D9	B_RSVD	B_DATA2	F19	B_CAD11	B_OE
A7	A_CAD3	A_DATA5	D10	B_CCD2	B_CD2	G1	GND	GND
A8	A_CAD0	A_DATA3	D11	B_CAD26	B_ADDR0	G2	A_CAD18	A_ADDR7
A9	B_CAD29	B_DATA1	D12	B_CAD24	B_ADDR2	G4	A_CAD19	A_ADDR25
A10	B_CSTSCHG	B_BVD1(STSCHG/RI)	D13	B_CAD23	B_ADDR3	G5	A_CAD17	A_ADDR24
A11	VCC	VCC	D14	VCC	VCC	G6	A_CC/BE2	A_ADDR12
A12	B_CC/BE3	B_REG	D15	B_CFRAME	B_ADDR23	G7	A_CAD4	A_DATA12
A13	B_CREQ	B_INPACK	D16	B_CBLOCK	B_ADDR19	G13	B_CAD7	B_DATA7
A14	B_CVS2	B_VS2	D18	B_RSVD	B_ADDR18	G14	B_CAD10	B_CE2
A15	B_CAD17	B_ADDR24	D19	B_CC/BE1	B_ADDR8	G15	B_CAD9	B_ADDR10
A16	GND	GND	E1	VCC	VCC	G16	B_CC/BE0	B_CE1
A17	B_CCLK	B_ADDR16	E2	A_CCLK	A_ADDR16	G18	B_CAD8	B_DATA15
A18	B_CDEVSEL	B_ADDR21	E4	A_CGNT	A_WE	G19	GND	GND
B1	A_CPAR	A_ADDR13	E5	A_CDEVSEL	A_ADDR21	H1	A_CAD20	A_ADDR6
B2	A_RSVD	A_ADDR18	E6	VCC	VCC	H2	A_CRST	A_RESET
B3	A_CAD16	A_ADDR17	E7	A_RSVD	A_DATA14	H4	A_CAD21	A_ADDR5
B4	A_CAD15	A_IOWR	E8	A_CAD1	A_DATA4	H5	A_CAD22	A_ADDR4
B5	A_CAD11	A_OE	E9	B_CAD31	B_DATA10	H6	A_CVS2	A_VS2
B6	VCCA	VCCA	E10	B_CAD27	B_DATA0	H14	B_CAD4	B_DATA12
B7	A_CAD6	A_DATA13	E11	B_CINT	B_READY(IREQ)	H15	B_RSVD	B_DATA14
B8	A_CAD2	A_DATA11	E12	B_CAD25	B_ADDR1	H16	B_CAD5	B_DATA6
B9	B_CAD30	B_DATA9	E13	B_CAD21	B_ADDR5	H18	B_CAD6	B_DATA13
B10	B_CCLKRUN	B_WP(IOIS16)	E14	B_CAD19	B_ADDR25	H19	B_CAD3	B_DATA5
B11	B_CVS1	B_VS1	E15	B_CC/BE2	B_ADDR12	J1	A_CAD23	A_ADDR3
B12	VCCB	VCCB	E16	B_CAD16	B_ADDR17	J2	A_CC/BE3	A_REG
B13	B_CAD22	B_ADDR4	E18	B_CAD14	B_ADDR9	J4	A_CREQ	A_INPACK
B14	B_CAD20	B_ADDR6	E19	VCC	VCC	J5	A_CAD24	A_ADDR2
B15	B_CAD18	B_ADDR7	F1	VCCA	VCCA	J6	A_CAD25	A_ADDR1
B16	B_CIRDY	B_ADDR15	F2	A_CFRAME	A_ADDR23	J14	VCC	VCC
B17	B_CTRDY	B_ADDR22	F4	A_CIRDY	A_ADDR15	J15	B_CAD1	B_DATA4
B18	B_CGNT	B_WE	F5	A_CTRDY	A_ADDR22	J16	B_CAD2	B_DATA11
B19	B_CSTOP	B_ADDR20	F6	A_CAD9	A_ADDR10	J18	B_CAD0	B_DATA3
C1	GND	GND	F7	A_CAD7	A_DATA7	J19	B_CCD1	B_CD1
C2	A_CBLOCK	A_ADDR19	F8	A_CCD1	A_CD1	K1	A_CVS1	A_VS1
C18	B_CPERR	B_ADDR14	F9	B_CAD28	B_DATA8	K2	A_CINT	A_READY(IREQ)
C19	B_CPAR	B_ADDR13	F10	B_CAUDIO	B_BVD2(SPKR)	K4	A_CSERR	A_WAIT
D1	A_CPERR	A_ADDR14	F11	B_CSERR	B_WAIT	K5	VCCA	VCCA
D2	A_CSTOP	A_ADDR20	F12	GND	GND	K6	A_CAD26	A_ADDR0
D4	A_CAD14	A_ADDR9	F13	B_CRST	B_RESET	K14	GNT	GNT

Table 2–1. GJG Terminals Sorted Alphanumerically for CardBus // 16-Bit Signals (continued)

TERM. NO.	SIGNAL NAME		TERM. NO.	SIGNAL NAME		TERM. NO.	SIGNAL NAME	
	CARDBUS	16-BIT		CARDBUS	16-BIT		CARDBUS	16-BIT
K15	PCLK	PCLK	P9	MFUNC2	MFUNC2	T18	FRAME	FRAME
K18	CLKRUN	CLKRUN	P10	MFUNC1	MFUNC1	T19	IRDY	IRDY
K19	PRST	PRST	P11	GRST	GRST	U1	ZV_UV3	ZV_UV3
L1	A_CSTSCHG	A_BVD1(STSCHG/RI)	P12	IRQSER	IRQSER	U2	ZV_UV6	ZV_UV6
L2	A_CCLKRUN	A_WP(IOIS16)	P13	AD6	AD6	U18	TRDY	TRDY
L4	A_CCD2	A_CD2	P14	AD9	AD9	U19	DEVSEL	DEVSEL
L5	A_CAD27	A_DATA0	P15	VCC	VCC	V1	ZV_UV5	ZV_UV5
L6	A_CAUDIO	A_BVD2(SPKR)	P16	AD19	AD19	V2	ZV_SCLK	ZV_SCLK
L14	REQ	REQ	P18	AD21	AD21	V3	ZV_LRCLK	ZV_LRCLK
L15	AD31	AD31	P19	AD20	AD20	V4	ZV_PCLK	ZV_PCLK
L16	AD28	AD28	R1	ZV_Y7	ZV_Y7	V5	RSVD	RSVD
L18	AD30	AD30	R2	ZV_UV0	ZV_UV0	V6	RSVD	RSVD
L19	AD29	AD29	R4	ZV_UV2	ZV_UV2	V7	RSVD	RSVD
M1	A_CAD29	A_DATA1	R5	MFUNC6	MFUNC6	V8	RSVD	RSVD
M2	GND	GND	R6	RSVD	RSVD	V9	SCL	SCL
M4	A_CAD30	A_DATA9	R7	RSVD	RSVD	V10	VCC	VCC
M5	A_RSVD	A_DATA2	R8	RSVD	RSVD	V11	DATA	DATA
M6	A_CAD28	A_DATA8	R9	MFUNC3	MFUNC3	V12	AD0	AD0
M14	C/BE3	C/BE3	R10	SUSPEND	SUSPEND	V13	VCC	VCC
M15	AD27	AD27	R11	RI_OUT	RI_OUT	V14	GND	GND
M16	AD26	AD26	R12	AD2	AD2	V15	AD11	AD11
M18	AD25	AD25	R13	AD5	AD5	V16	AD14	AD14
M19	AD24	AD24	R14	AD8	AD8	V17	PAR	PAR
N1	ZV_HREF	ZV_HREF	R15	AD16	AD16	V18	PERR	PERR
N2	ZV_VSYNC	ZV_VSYNC	R16	C/BE2	C/BE2	V19	STOP	STOP
N4	ZV_Y0	ZV_Y0	R18	AD18	AD18	W2	ZV_UV7	ZV_UV7
N5	ZV_Y1	ZV_Y1	R19	AD17	AD17	W3	ZV_MCLK	ZV_MCLK
N6	ZV_Y2	ZV_Y2	T1	ZV_UV1	ZV_UV1	W4	ZV_SDATA	ZV_SDATA
N7	A_CAD31	A_DATA10	T2	ZV_UV4	ZV_UV4	W5	MFUNC5	MFUNC5
N13	AD3	AD3	T4	GND	GND	W6	RSVD	RSVD
N14	AD22	AD22	T5	VCC	VCC	W7	RSVD	RSVD
N15	AD23	AD23	T6	RSVD	RSVD	W8	RSVD	RSVD
N16	GND	GND	T7	GND	GND	W9	SDA	SDA
N18	VCCP	VCCP	T8	RSVD	RSVD	W10	MFUNC0	MFUNC0
N19	IDSEL/MFUNC7	IDSEL/MFUNC7	T9	MFUNC4	MFUNC4	W11	LATCH	LATCH
P1	VCC	VCC	T10	SPKROUT	SPKROUT	W12	GND	GND
P2	ZV_Y3	ZV_Y3	T11	CLOCK	CLOCK	W13	VCCP	VCCP
P4	ZV_Y4	ZV_Y4	T12	AD1	AD1	W14	AD7	AD7
P5	ZV_Y5	ZV_Y5	T13	AD4	AD4	W15	AD10	AD10
P6	ZV_Y6	ZV_Y6	T14	C/BE0	C/BE0	W16	AD13	AD13
P7	RSVD	RSVD	T15	AD12	AD12	W17	AD15	AD15
P8	RSVD	RSVD	T16	C/BE1	C/BE1	W18	SERR	SERR

Table 2–2. CardBus PC Card Signal Names Sorted Alphanumerically to GJG Terminal Number

SIGNAL NAME	TERM. NO.						
A_CAD0	A8	A_CFRAME	F2	AD26	M16	B_CC/BE3	A12
A_CAD1	E8	A_CGNT	E4	AD27	M15	B_CCD1	J19
A_CAD2	B8	A_CINT	K2	AD28	L16	B_CCD2	D10
A_CAD3	A7	A_CIRDY	F4	AD29	L19	B_CCLK	A17
A_CAD4	G7	A_CPAR	B1	AD30	L18	B_CCLKRUN	B10
A_CAD5	D7	A_CPERR	D1	AD31	L15	B_CDEVSEL	A18
A_CAD6	B7	A_CREQ	J4	B_CAD0	J18	B_CFRAME	D15
A_CAD7	F7	A_CRST	H2	B_CAD1	J15	B_CGNT	B18
A_CAD8	A6	A_CSERR	K4	B_CAD2	J16	B_CINT	E11
A_CAD9	F6	A_CSTOP	D2	B_CAD3	H19	B_CIRDY	B16
A_CAD10	A5	A_CSTSCHG	L1	B_CAD4	H14	B_CPAR	C19
A_CAD11	B5	A_CTRDY	F5	B_CAD5	H16	B_CPERR	C18
A_CAD12	A4	A_CVS1	K1	B_CAD6	H18	B_CREQ	A13
A_CAD13	D5	A_CVS2	H6	B_CAD7	G13	B_CRST	F13
A_CAD14	D4	A_RSVD	B2	B_CAD8	G18	B_CSERR	F11
A_CAD15	B4	A_RSVD	E7	B_CAD9	G15	B_CSTOP	B19
A_CAD16	B3	A_RSVD	M5	B_CAD10	G14	B_CSTSCHG	A10
A_CAD17	G5	AD0	V12	B_CAD11	F19	B_CTRDY	B17
A_CAD18	G2	AD1	T12	B_CAD12	F15	B_CVS1	B11
A_CAD19	G4	AD2	R12	B_CAD13	F16	B_CVS2	A14
A_CAD20	H1	AD3	N13	B_CAD14	E18	B_RSVD	D9
A_CAD21	H4	AD4	T13	B_CAD15	F14	B_RSVD	D18
A_CAD22	H5	AD5	R13	B_CAD16	E16	B_RSVD	H15
A_CAD23	J1	AD6	P13	B_CAD17	A15	C/BE0	T14
A_CAD24	J5	AD7	W14	B_CAD18	B15	C/BE1	T16
A_CAD25	J6	AD8	R14	B_CAD19	E14	C/BE2	R16
A_CAD26	K6	AD9	P14	B_CAD20	B14	C/BE3	M14
A_CAD27	L5	AD10	W15	B_CAD21	E13	CLKRUN	K18
A_CAD28	M6	AD11	V15	B_CAD22	B13	CLOCK	T11
A_CAD29	M1	AD12	T15	B_CAD23	D13	DATA	V11
A_CAD30	M4	AD13	W16	B_CAD24	D12	DEVSEL	U19
A_CAD31	N7	AD14	V16	B_CAD25	E12	FRAME	T18
A_AUDIO	L6	AD15	W17	B_CAD26	D11	GND	A3
A_CBLOCK	C2	AD16	R15	B_CAD27	E10	GND	A16
A_CC/BE0	D6	AD17	R19	B_CAD28	F9	GND	C1
A_CC/BE1	A2	AD18	R18	B_CAD29	A9	GND	D8
A_CC/BE2	G6	AD19	P16	B_CAD30	B9	GND	F12
A_CC/BE3	J2	AD20	P19	B_CAD31	E9	GND	G1
A_CCD1	F8	AD21	P18	B_AUDIO	F10	GND	G19
A_CCD2	L4	AD22	N14	B_CBLOCK	D16	GND	M2
A_CCLK	E2	AD23	N15	B_CC/BE0	G16	GND	N16
A_CCLKRUN	L2	AD24	M19	B_CC/BE1	D19	GND	T4
A_CDEVSEL	E5	AD25	M18	B_CC/BE2	E15	GND	T7

**Table 2–2. CardBus PC Card Signal Names Sorted Alphanumerically to GJG Terminal Number
(continued)**

SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.
GND	V14	RSVD	P7	V _{CC}	A11	ZV_PCLK	V4
GND	W12	RSVD	P8	V _{CC}	D14	ZV_SCLK	V2
$\overline{\text{GNT}}$	K14	RSVD	R6	V _{CC}	E1	ZV_SDATA	W4
$\overline{\text{GRST}}$	P11	RSVD	R7	V _{CC}	E6	ZV_UV0	R2
IDSEL/MFUNC7	N19	RSVD	R8	V _{CC}	E19	ZV_UV1	T1
$\overline{\text{IRDY}}$	T19	RSVD	T6	V _{CC}	J14	ZV_UV2	R4
IRQSER	P12	RSVD	T8	V _{CC}	P1	ZV_UV3	U1
LATCH	W11	RSVD	V5	V _{CC}	P15	ZV_UV4	T2
MFUNC0	W10	RSVD	V6	V _{CC}	T5	ZV_UV5	V1
MFUNC1	P10	RSVD	V7	V _{CC}	V10	ZV_UV6	U2
MFUNC2	P9	RSVD	V8	V _{CC}	V13	ZV_UV7	W2
MFUNC3	R9	RSVD	W6	V _{CCA}	B6	ZV_VSYNC	N2
MFUNC4	T9	RSVD	W7	V _{CCA}	F1	ZV_Y0	N4
MFUNC5	W5	RSVD	W8	V _{CCA}	K5	ZV_Y1	N5
MFUNC6	R5	SCL	V9	V _{CCB}	B12	ZV_Y2	N6
PAR	V17	SDA	W9	V _{CCB}	F18	ZV_Y3	P2
PCLK	K15	$\overline{\text{SERR}}$	W18	V _{CCP}	N18	ZV_Y4	P4
$\overline{\text{PERR}}$	V18	$\overline{\text{SPKROUT}}$	T10	V _{CCP}	W13	ZV_Y5	P5
$\overline{\text{PRST}}$	K19	$\overline{\text{STOP}}$	V19	ZV_HREF	N1	ZV_Y6	P6
$\overline{\text{REQ}}$	L14	$\overline{\text{SUSPEND}}$	R10	ZV_LRCLK	V3	ZV_Y7	R1
$\overline{\text{RI_OUT}}$	R11	$\overline{\text{TRDY}}$	U18	ZV_MCLK	W3		

Table 2–3. 16-Bit PC Card Signal Names Sorted Alphanumerically to GJG Terminal Number

SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.
A_ADDR0	K6	A_DATA11	B8	AD26	M16	B_DATA5	H19
A_ADDR1	J6	A_DATA12	G7	AD27	M15	B_DATA6	H16
A_ADDR2	J5	A_DATA13	B7	AD28	L16	B_DATA7	G13
A_ADDR3	J1	A_DATA14	E7	AD29	L19	B_DATA8	F9
A_ADDR4	H5	A_DATA15	A6	AD30	L18	B_DATA9	B9
A_ADDR5	H4	A_INPACK	J4	AD31	L15	B_DATA10	E9
A_ADDR6	H1	A_IORD	D5	B_ADDR0	D11	B_DATA11	J16
A_ADDR7	G2	A_IOWR	B4	B_ADDR1	E12	B_DATA12	H14
A_ADDR8	A2	A_OE	B5	B_ADDR2	D12	B_DATA13	H18
A_ADDR9	D4	A_READY(IREQ)	K2	B_ADDR3	D13	B_DATA14	H15
A_ADDR10	F6	A_REG	J2	B_ADDR4	B13	B_DATA15	G18
A_ADDR11	A4	A_RESET	H2	B_ADDR5	E13	B_INPACK	A13
A_ADDR12	G6	A_VS1	K1	B_ADDR6	B14	B_IORD	F16
A_ADDR13	B1	A_VS2	H6	B_ADDR7	B15	B_IOWR	F14
A_ADDR14	D1	A_WAIT	K4	B_ADDR8	D19	B_OE	F19
A_ADDR15	F4	A_WE	E4	B_ADDR9	E18	B_READY(IREQ)	E11
A_ADDR16	E2	A_WP(IOIS16)	L2	B_ADDR10	G15	B_REG	A12
A_ADDR17	B3	AD0	V12	B_ADDR11	F15	B_RESET	F13
A_ADDR18	B2	AD1	T12	B_ADDR12	E15	B_VS1	B11
A_ADDR19	C2	AD2	R12	B_ADDR13	C19	B_VS2	A14
A_ADDR20	D2	AD3	N13	B_ADDR14	C18	B_WAIT	F11
A_ADDR21	E5	AD4	T13	B_ADDR15	B16	B_WE	B18
A_ADDR22	F5	AD5	R13	B_ADDR16	A17	B_WP(IOIS16)	B10
A_ADDR23	F2	AD6	P13	B_ADDR17	E16	C/BE0	T14
A_ADDR24	G5	AD7	W14	B_ADDR18	D18	C/BE1	T16
A_ADDR25	G4	AD8	R14	B_ADDR19	D16	C/BE2	R16
A_BVD1(STSCHG/RI)	L1	AD9	P14	B_ADDR20	B19	C/BE3	M14
A_BVD2(SPKR)	L6	AD10	W15	B_ADDR21	A18	CLKRUN	K18
A_CD1	F8	AD11	V15	B_ADDR22	B17	CLOCK	T11
A_CD2	L4	AD12	T15	B_ADDR23	D15	DATA	V11
A_CE1	D6	AD13	W16	B_ADDR24	A15	DEVSEL	U19
A_CE2	A5	AD14	V16	B_ADDR25	E14	FRAME	T18
A_DATA0	L5	AD15	W17	B_BVD1(STSCHG/RI)	A10	GND	A3
A_DATA1	M1	AD16	R15	B_BVD2(SPKR)	F10	GND	A16
A_DATA2	M5	AD17	R19	B_CD1	J19	GND	C1
A_DATA3	A8	AD18	R18	B_CD2	D10	GND	D8
A_DATA4	E8	AD19	P16	B_CE1	G16	GND	F12
A_DATA5	A7	AD20	P19	B_CE2	G14	GND	G1
A_DATA6	D7	AD21	P18	B_DATA0	E10	GND	G19
A_DATA7	F7	AD22	N14	B_DATA1	A9	GND	M2
A_DATA8	M6	AD23	N15	B_DATA2	D9	GND	N16
A_DATA9	M4	AD24	M19	B_DATA3	J18	GND	T4
A_DATA10	N7	AD25	M18	B_DATA4	J15	GND	T7

Table 2–3. 16-Bit PC Card Signal Names Sorted Alphanumerically to GJG Terminal Number (continued)

SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.	SIGNAL NAME	TERM. NO.
GND	V14	RSVD	P7	V _{CC}	A11	ZV_PCLK	V4
GND	W12	RSVD	P8	V _{CC}	D14	ZV_SCLK	V2
$\overline{\text{GNT}}$	K14	RSVD	R6	V _{CC}	E1	ZV_SDATA	W4
$\overline{\text{GRST}}$	P11	RSVD	R7	V _{CC}	E6	ZV_UV0	R2
IDSEL/MFUNC7	N19	RSVD	R8	V _{CC}	E19	ZV_UV1	T1
$\overline{\text{IRDY}}$	T19	RSVD	T6	V _{CC}	J14	ZV_UV2	R4
IRQSER	P12	RSVD	T8	V _{CC}	P1	ZV_UV3	U1
LATCH	W11	RSVD	V5	V _{CC}	P15	ZV_UV4	T2
MFUNC0	W10	RSVD	V6	V _{CC}	T5	ZV_UV5	V1
MFUNC1	P10	RSVD	V7	V _{CC}	V10	ZV_UV6	U2
MFUNC2	P9	RSVD	V8	V _{CC}	V13	ZV_UV7	W2
MFUNC3	R9	RSVD	W6	V _{CCA}	B6	ZV_VSYNC	N2
MFUNC4	T9	RSVD	W7	V _{CCA}	F1	ZV_Y0	N4
MFUNC5	W5	RSVD	W8	V _{CCA}	K5	ZV_Y1	N5
MFUNC6	R5	SCL	V9	V _{CCB}	B12	ZV_Y2	N6
PAR	V17	SDA	W9	V _{CCB}	F18	ZV_Y3	P2
PCLK	K15	$\overline{\text{SERR}}$	W18	V _{CCP}	N18	ZV_Y4	P4
PERR	V18	$\overline{\text{SPKROUT}}$	T10	V _{CCP}	W13	ZV_Y5	P5
$\overline{\text{PRST}}$	K19	$\overline{\text{STOP}}$	V19	ZV_HREF	N1	ZV_Y6	P6
$\overline{\text{REQ}}$	L14	$\overline{\text{SUSPEND}}$	R10	ZV_LRCLK	V3	ZV_Y7	R1
$\overline{\text{RI_OUT}}$	R11	$\overline{\text{TRDY}}$	U18	ZV_MCLK	W3		

The terminals are grouped in tables by functionality, such as PCI system function and power supply function (see Table 2–4 through Table 2–17). The terminal numbers also are listed for convenient reference.

Table 2–4. Power-Supply Terminals

TERMINAL		FUNCTION
NAME	NO.	
GND	A3, A16, C1, D8, F12, G1, G19, M2, N16, T4, T7, V14, W12	Device ground terminals
VCC	A11, D14, E1, E6, E19, J14, P1, P15, T5, V10, V13	Power-supply terminal for core logic (3.3 Vdc)
VCCA	B6, F1, K5	Clamp voltage for PC Card A interface. Indicates Card A signaling environment.
VCCB	B12, F18	Clamp voltage for PC Card B interface. Indicates Card B signaling environment.
VCCP	N18, W13	Clamp voltage for PCI signaling (3.3 Vdc or 5 Vdc)

Table 2–5. PC Card Power-Switch Terminals

TERMINAL		I/O	FUNCTION
NAME	NO.		
CLOCK	T11	I/O	3-line power-switch clock. Information on the DATA line is sampled at the rising edge of CLOCK. This terminal defaults as an input which means an external clock source must be used. If the internal ring oscillator is used, an external CLOCK source is not required. The internal oscillator may be enabled by setting bit 27 (P2CCLK) of the system control register (PCI offset 80h, see Section 4.29) to a 1b. A 43-kΩ pull-down resistor should be tied to this terminal.
DATA	V11	O	3-line power-switch data. DATA is used to serially communicate socket power-control information to the power switch.
LATCH	W11	O	3-line power-switch latch. LATCH is asserted by the PCI1451A device to indicate to the PC Card power switch that the data on the DATA line is valid.

Table 2–6. PCI System Terminals

TERMINAL		I/O	FUNCTION
NAME	NO.		
$\overline{\text{CLKRUN}}$	K18	I/O	PCI clock run. $\overline{\text{CLKRUN}}$ is used by the central resource to request permission to stop the PCI clock or to slow it down, and the PCI1451A device responds accordingly. If $\overline{\text{CLKRUN}}$ is not implemented, this terminal should be tied low. $\overline{\text{CLKRUN}}$ is enabled by default by bit 1 (KEEPCLK) in the system control register (PCI offset 80h, see Section 4.29).
$\overline{\text{GRST}}$	P11	I	Global reset. When global reset is asserted, $\overline{\text{GRST}}$ causes the PCI1451A device to place all output buffers in a high-impedance state and reset all internal registers. When $\overline{\text{GRST}}$ is asserted, the device is completely in its default state. For systems that require wake-up from D3, $\overline{\text{GRST}}$ normally is asserted only during initial boot. $\overline{\text{PRST}}$ should be asserted following initial boot so that PME context is retained when transitioning from D3 to D0. For systems that do not require wake-up from D3, $\overline{\text{GRST}}$ should be tied to $\overline{\text{PRST}}$.
PCLK	K15	I	PCI bus clock. PCLK provides timing for all transactions on the PCI bus. All PCI signals are sampled at the rising edge of PCLK.
$\overline{\text{PRST}}$	K19	I	PCI bus reset. When the PCI bus reset is asserted, $\overline{\text{PRST}}$ causes the PCI1451A device to place all output buffers in a high-impedance state and reset all internal registers. When $\overline{\text{PRST}}$ is asserted, the device is completely nonfunctional. After $\overline{\text{PRST}}$ is deasserted, the PCI1451A device is in its default state. When the $\overline{\text{SUSPEND}}$ mode is enabled, the device is protected from $\overline{\text{PRST}}$ and the internal registers are preserved. All outputs are placed in a high-impedance state.

Table 2–7. PCI Address and Data Terminals

TERMINAL		I/O	FUNCTION
NAME	NO.		
AD31	L15	I/O	PCI address/data bus. These signals make up the multiplexed PCI address and data bus on the primary interface. During the address phase of a primary bus PCI cycle, AD31–AD0 contain a 32-bit address or other destination information. During the data phase, AD31–AD0 contain data.
AD30	L18		
AD29	L19		
AD28	L16		
AD27	M15		
AD26	M16		
AD25	M18		
AD24	M19		
AD23	N15		
AD22	N14		
AD21	P18		
AD20	P19		
AD19	P16		
AD18	R18		
AD17	R19		
AD16	R15		
AD15	W17		
AD14	V16		
AD13	W16		
AD12	T15		
AD11	V15		
AD10	W15		
AD9	P14		
AD8	R14		
AD7	W14		
AD6	P13		
AD5	R13		
AD4	T13		
AD3	N13		
AD2	R12		
AD1	T12		
AD0	V12		
$\overline{C/BE3}$	M14	I/O	PCI bus commands and byte enables. These signals are multiplexed on the same PCI terminals. During the address phase of a primary bus PCI cycle, $\overline{C/BE3}$ – $\overline{C/BE0}$ define the bus command. During the data phase, this 4-bit bus is used as byte enables. The byte enables determine which byte paths of the full 32-bit data bus carry meaningful data. $\overline{C/BE0}$ applies to byte 0 (AD7–AD0), $\overline{C/BE1}$ applies to byte 1 (AD15–AD8), $\overline{C/BE2}$ applies to byte 2 (AD23–AD16), and $\overline{C/BE3}$ applies to byte 3 (AD31–AD24).
$\overline{C/BE2}$	R16		
$\overline{C/BE1}$	T16		
$\overline{C/BE0}$	T14		
PAR	V17	I/O	PCI bus parity. In all PCI bus read and write cycles, the PCI1451A device calculates even parity across the AD31–AD0 and $\overline{C/BE3}$ – $\overline{C/BE0}$ buses. As an initiator during PCI cycles, the PCI1451A device outputs this parity indicator with a one-PCLK delay. As a target during PCI cycles, the calculated parity is compared to the initiator's parity indicator. A compare error results in the assertion of a parity error (PERR).

Table 2–8. PCI Interface Control Terminals

TERMINAL NAME	NO.	I/O	FUNCTION
$\overline{\text{DEVSEL}}$	U19	I/O	PCI device select. The PCI1451A device asserts $\overline{\text{DEVSEL}}$ to claim a PCI cycle as the target device. As a PCI initiator on the bus, the PCI1451A device monitors $\overline{\text{DEVSEL}}$ until a target responds. If no target responds before timeout occurs, the PCI1451A device terminates the cycle with an initiator abort.
$\overline{\text{FRAME}}$	T18	I/O	PCI cycle frame. $\overline{\text{FRAME}}$ is driven by the initiator of a bus cycle. $\overline{\text{FRAME}}$ is asserted to indicate that a bus transaction is beginning, and data transfers continue while this signal is asserted. When $\overline{\text{FRAME}}$ is deasserted, the PCI bus transaction is in the final data phase.
$\overline{\text{GNT}}$	K14	I	PCI bus grant. $\overline{\text{GNT}}$ is driven by the PCI bus arbiter to grant the PCI1451A device access to the PCI bus after the current data transaction has completed. $\overline{\text{GNT}}$ may or may not follow a PCI bus request, depending on the PCI bus parking algorithm.
IDSEL/MFUNC7	N19	I	Initialization device select. IDSEL selects the PCI1451A device during configuration space accesses. IDSEL can be connected to one of the upper 24 PCI address lines on the PCI bus. If the LATCH terminal (W12/W11) has an external pulldown resistor, this terminal is configurable as MFUNC7 and IDSEL defaults to the AD23 terminal.
$\overline{\text{IRDY}}$	T19	I/O	PCI initiator ready. $\overline{\text{IRDY}}$ indicates the PCI bus initiator's ability to complete the current data phase of the transaction. A data phase is completed on a rising edge of PCLK where both $\overline{\text{IRDY}}$ and $\overline{\text{TRDY}}$ are asserted. Until $\overline{\text{IRDY}}$ and $\overline{\text{TRDY}}$ are both sampled asserted, wait states are inserted.
$\overline{\text{LOCK}}$ (MFUNC7)	N19	I/O	PCI bus lock. MFUNC7/ $\overline{\text{LOCK}}$ can be configured as PCI $\overline{\text{LOCK}}$ and used to gain exclusive access downstream. Since this functionality is not typically used, other functions may be accessed through this terminal. MFUNC7/ $\overline{\text{LOCK}}$ defaults to and can be configured through the multifunction routing status register (PCI offset 8Ch, see Section 4.36).
$\overline{\text{PERR}}$	V18	I/O	PCI parity error indicator. $\overline{\text{PERR}}$ is driven by a PCI device to indicate that calculated parity does not match PAR when $\overline{\text{PERR}}$ is enabled through bit 6 (PERR_EN) of the command register (PCI offset 04h, see Section 4.4).
$\overline{\text{REQ}}$	L14	O	PCI bus request. $\overline{\text{REQ}}$ is asserted by the PCI1451A device to request access to the PCI bus as an initiator.
$\overline{\text{SERR}}$	W18	O	PCI system error. $\overline{\text{SERR}}$ is an output that is pulsed from the PCI1451A device when enabled through bit 8 (SERR_EN) of the command register (PCI offset 04h, see Section 4.4), indicating a system error has occurred. The PCI1451A device need not be the target of the PCI cycle to assert this signal. When $\overline{\text{SERR}}$ is enabled by bit 1 (CSERREN) in the bridge control register (PCI offset 3Eh, see Section 4.25), this signal also pulses, indicating that an address parity error has occurred on a CardBus interface.
$\overline{\text{STOP}}$	V19	I/O	PCI cycle stop signal. $\overline{\text{STOP}}$ is driven by a PCI target to request the initiator to stop the current PCI bus transaction. $\overline{\text{STOP}}$ is used for target disconnects and is commonly asserted by target devices that do not support burst data transfers.
$\overline{\text{TRDY}}$	U18	I/O	PCI target ready. $\overline{\text{TRDY}}$ indicates the primary bus target's ability to complete the current data phase of the transaction. A data phase is completed on a rising edge of PCLK when both $\overline{\text{IRDY}}$ and $\overline{\text{TRDY}}$ are asserted. Until both $\overline{\text{IRDY}}$ and $\overline{\text{TRDY}}$ are asserted, wait states are inserted.

Table 2–9. System Interrupt Terminals

TERMINAL NAME	NO.	I/O	FUNCTION
$\overline{\text{INTA}}$ (MFUNC0)	W10	I/O	Parallel PCI interrupt. $\overline{\text{INTA}}$ can be mapped to MFUNC0 when parallel PCI interrupts are used. See Section 3.5, <i>Programmable Interrupt Subsystem</i> , for details on interrupt signaling. MFUNC0/ $\overline{\text{INTA}}$ defaults to a general-purpose input.
$\overline{\text{INTB}}$ (MFUNC1)	P10	I/O	Parallel PCI interrupt. $\overline{\text{INTB}}$ can be mapped to MFUNC1 when parallel PCI interrupts are used. See Section 3.5, <i>Programmable Interrupt Subsystem</i> , for details on interrupt signaling. MFUNC1/ $\overline{\text{INTB}}$ defaults to a general-purpose input.
IRQSER	P12	I/O	Serial interrupt signal. IRQSER provides the IRQSER-style serial interrupting scheme. Serialized PCI interrupts can also be sent in the IRQSER stream. See Section 3.5, <i>Programmable Interrupt Subsystem</i> , for details on interrupt signaling.
MFUNC6	R5	O	Interrupt request/secondary functions multiplexed. The primary function of these terminals is to provide programmable options supported by the PCI1451A device. These interrupt multiplexer outputs can be mapped to various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for options. All of these terminals have secondary functions, such as PCI interrupts, PC/PCI DMA, GPE request/grant, ring indicate output, and zoomed-video (ZV) status, that can be selected with the appropriate programming of this register. When the secondary functions are enabled, the respective terminals are not available for multifunction routing. See Section 4.36, <i>Multifunction Routing Status Register</i> , for programming options.
MFUNC5	W5		
MFUNC4	T9		
MFUNC3	R9		
MFUNC2	P9		
MFUNC1	P10		
MFUNC0	W10		
$\overline{\text{RI_OUT/PME}}$	R11	O	Ring indicate out and power-management event output. Terminal provides an output to the system for ring-indicate or PME signals. Alternately, $\overline{\text{RI_OUT}}$ can be routed on MFUNC7.

Table 2–10. PC/PCI DMA Terminals

TERMINAL NAME	NO.	I/O	FUNCTION
$\overline{\text{PCGNT}}$ (MFUNC2)	P9	I/O	PC/PCI DMA grant. $\overline{\text{PCGNT}}$ is used to grant the DMA channel to a requester in a system supporting the PC/PCI DMA scheme. $\overline{\text{PCGNT}}$ is available on MFUNC2 or MFUNC3. This terminal is also used for the serial EEPROM interface.
$\overline{\text{PCGNT}}$ (MFUNC3)	R9		
$\overline{\text{PCREQ}}$ (MFUNC7)	N19	O	PC/PCI DMA request. $\overline{\text{PCREQ}}$ is used to request DMA transfers as $\overline{\text{DREQ}}$ in a system supporting the PC/PCI DMA scheme. $\overline{\text{PCREQ}}$ is available on MFUNC7, MFUNC4, or MFUNC0. This terminal is also used for the serial EEPROM interface.
$\overline{\text{PCREQ}}$ (MFUNC4)	T9		
$\overline{\text{PCREQ}}$ (MFUNC0)	W10		

Table 2–11. Zoomed-Video Terminals

TERMINAL NAME	NO.	I/O AND MEMORY INTERFACE SIGNAL	I/O	FUNCTION
ZV_HREF	N1	A10	O	Horizontal sync to the ZV port
ZV_VSYNC	N2	A11	O	Vertical sync to the ZV port
ZV_Y7	R1	A20	O	Video data to the ZV port in YV:4:2:2 format
ZV_Y6	P6	A14		
ZV_Y5	P5	A19		
ZV_Y4	P4	A13		
ZV_Y3	P2	A18		
ZV_Y2	N6	A8		
ZV_Y1	N5	A17		
ZV_Y0	N4	A9		
ZV_UV7	W2	A25	O	Video data to the ZV port in YV:4:2:2 format
ZV_UV6	U2	A12		
ZV_UV5	V1	A24		
ZV_UV4	T2	A15		
ZV_UV3	U1	A23		
ZV_UV2	R4	A16		
ZV_UV1	T1	A22		
ZV_UV0	R2	A21		
ZV_SCLK	V2	A7	O	Audio SCLK PCM
ZV_MCLK	W3	A6	O	Audio MCLK PCM
ZV_PCLK	V4	<u>IOIS16</u>	O	Pixel clock to the ZV port
ZV_LRCLK	V3	<u>INPACK</u>	O	Audio LRCLK PCM
ZV_SDATA	W4	<u>SPKR</u>	O	Audio SDATA PCM

Table 2–12. Miscellaneous Terminals

TERMINAL NAME	NO.	I/O	FUNCTION
MFUNC0	W10	I/O	Multifunction terminal 0. Defaults as a general-purpose input (GPIO), and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
MFUNC1	P10	I/O	Multifunction terminal 1. Defaults as a general-purpose input (GPIO), and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
MFUNC2	P9	I/O	Multifunction terminal 2. Defaults as a general-purpose input (GPIO), and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
MFUNC3	R9	I/O	Multifunction terminal 3. Defaults as a general-purpose input (GPIO), and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
MFUNC4	T9	I/O	Multifunction terminal 4. Defaults as a high-impedance reserved input, and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
MFUNC5	W5	I/O	Multifunction terminal 5. Defaults as a high-impedance reserved input, and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
MFUNC6	R5	I/O	Multifunction terminal 6. Defaults as a high-impedance reserved input, and can be programmed to perform various functions. See Section 4.36, <i>Multifunction Routing Status Register</i> , for configuration details.
IDSEL/MFUNC7	N19	I/O	IDSEL and multifunction terminal 7. Defaults as IDSEL, but can be used as a multifunction terminal. See Section 4.36, <i>Multifunction Routing Status Register</i> and Section 3.4, <i>PC Card Applications Overview</i> , for configuration details.
SCL	V9	I/O	Serial ROM clock. This terminal provides the SCL serial clock signaling in a two-wire serial ROM implementation, and is sensed at reset for serial ROM detection.
SDA	W9	I/O	Serial ROM data. This terminal provides the SDA serial data signaling in a two-wire serial ROM implementation.
$\overline{\text{SPKROUT}}$	T10	O	Speaker output. SPKROUT is the output to the host system that can carry $\overline{\text{SPKR}}$ or CAUDIO through the PCI1451A device from the PC Card interface. SPKROUT is driven as the XOR combination of card $\overline{\text{SPKR}}$ /CAUDIO inputs.
$\overline{\text{SUSPEND}}$	R10	I	Suspend. $\overline{\text{SUSPEND}}$ is used to protect the internal registers from clearing when $\overline{\text{PRST}}$ is asserted. See Section 3.6.7, <i>Suspend Mode</i> for details.

Table 2–13. 16-Bit PC Card Address and Data Terminals (slots A and B)

TERMINAL			I/O	FUNCTION
NAME	NO.			
	SLOT A†	SLOT B‡		
ADDR25	G4	E14	O	PC Card address. 16-bit PC Card address lines. ADDR25 is the most significant bit.
ADDR24	G5	A15		
ADDR23	F2	D15		
ADDR22	F5	B17		
ADDR21	E5	A18		
ADDR20	D2	B19		
ADDR19	C2	D16		
ADDR18	B2	D18		
ADDR17	B3	E16		
ADDR16	E2	A17		
ADDR15	F4	B16		
ADDR14	D1	C18		
ADDR13	B1	C19		
ADDR12	G6	E15		
ADDR11	A4	F15		
ADDR10	F6	G15		
ADDR9	D4	E18		
ADDR8	A2	D19		
ADDR7	G2	B15		
ADDR6	H1	B14		
ADDR5	H4	E13		
ADDR4	H5	B13		
ADDR3	J1	D13		
ADDR2	J5	D12		
ADDR1	J6	E12		
ADDR0	K6	D11		
DATA15	A6	G18	I/O	PC Card data. 16-bit PC Card data lines. DATA15 is the most significant bit.
DATA14	E7	H15		
DATA13	B7	H18		
DATA12	G7	H14		
DATA11	B8	J16		
DATA10	N7	E9		
DATA9	M4	B9		
DATA8	M6	F9		
DATA7	F7	G13		
DATA6	D7	H16		
DATA5	A7	H19		
DATA4	E8	J15		
DATA3	A8	J18		
DATA2	M5	D9		
DATA1	M1	A9		
DATA0	L5	E10		

† Terminal name for slot A is preceded with A_. For example, the full name for terminal G4 is A_ADDR25.

‡ Terminal name for slot B is preceded with B_. For example, the full name for terminal E14 is B_ADDR25.

Table 2–14. 16-Bit PC Card Interface Control Terminals (slots A and B)

TERMINAL			I/O	FUNCTION
NAME	NO.			
	SLOT A†	SLOT B‡		
$\overline{\text{BVD1}}$ (STSCHG/RI)	L1	A10	I	Battery voltage detect 1. BVD1 is generated by 16-bit memory PC Cards that include batteries. BVD1 and BVD2 indicate the condition of the batteries on a memory PC Card. Both BVD1 and BVD2 are kept high when the battery is good. When BVD2 is low and BVD1 is high, the battery is weak and should be replaced. When BVD1 is low, the battery is no longer serviceable and the data in the memory PC Card is lost. See Section 5.6, <i>ExCA Card Status-Change Interrupt Configuration Register</i> , for the enable bits. See Section 5.5, <i>ExCA Card Status-Change Register</i> and Section 5.2, <i>ExCA Interface Status Register</i> , for the status bits for this signal. Status change. STSCHG is used to alert the system to a change in the READY, write protect, or battery voltage dead condition of a 16-bit I/O PC Card. Ring indicate. $\overline{\text{RI}}$ is used by 16-bit modem cards to indicate a ring detection.
$\overline{\text{BVD2}}$ (SPKR)	L6	F10	I	Battery voltage detect 2. BVD2 is generated by 16-bit memory PC Cards that include batteries. BVD2 and BVD1 indicate the condition of the batteries on a memory PC Card. Both BVD1 and BVD2 are high when the battery is good. When BVD2 is low and BVD1 is high, the battery is weak and should be replaced. When BVD1 is low, the battery is no longer serviceable and the data in the memory PC Card is lost. See Section 5.6, <i>ExCA Card Status-Change Interrupt Configuration Register</i> , for the enable bits. See Section 5.5, <i>ExCA Card Status-Change Register</i> and Section 5.2, <i>ExCA Interface Status Register</i> , for the status bits for this signal. Speaker. SPKR is an optional binary audio signal available only when the card and socket have been configured for the 16-bit I/O interface. The audio signals from cards A and B are combined by the PCI1451A device and are output on SPKROUT. DMA request. BVD2 can be used as the DMA request signal during DMA operations to a 16-bit PC Card that supports DMA. The PC Card asserts BVD2 to indicate a request for a DMA operation.
$\overline{\text{CD1}}$ $\overline{\text{CD2}}$	F8 L4	J19 D10	I	PC Card detect 1 and PC Card detect 2. $\overline{\text{CD1}}$ and $\overline{\text{CD2}}$ are internally connected to ground on the PC Card. When a PC Card is inserted into a socket, $\overline{\text{CD1}}$ and $\overline{\text{CD2}}$ are pulled low. For signal status, see Section 5.2, <i>ExCA Interface Status Register</i> .
$\overline{\text{CE1}}$ $\overline{\text{CE2}}$	D6 A5	G16 G14	O	Card enable 1 and card enable 2. $\overline{\text{CE1}}$ and $\overline{\text{CE2}}$ enable even- and odd-numbered address bytes. $\overline{\text{CE1}}$ enables even-numbered address bytes, and $\overline{\text{CE2}}$ enables odd-numbered address bytes.
$\overline{\text{INPACK}}$	J4	A13	I	Input acknowledge. $\overline{\text{INPACK}}$ is asserted by the PC Card when it can respond to an I/O read cycle at the current address. DMA request. $\overline{\text{INPACK}}$ can be used as the DMA request signal during DMA operations from a 16-bit PC Card that supports DMA. If used as a strobe, the PC Card asserts this signal to indicate a request for a DMA operation.
$\overline{\text{IORD}}$	D5	F16	O	I/O read. $\overline{\text{IORD}}$ is asserted by the PCI1451A device to enable 16-bit I/O PC Card data output during host I/O read cycles. DMA write. $\overline{\text{IORD}}$ is used as the DMA write strobe during DMA operations from a 16-bit PC Card that supports DMA. The PCI1451A device asserts $\overline{\text{IORD}}$ during DMA transfers from the PC Card to host memory.
$\overline{\text{IOWR}}$	B4	F14	O	I/O write. $\overline{\text{IOWR}}$ is driven low by the PCI1451A device to strobe write data into 16-bit I/O PC Cards during host I/O write cycles. DMA read. $\overline{\text{IOWR}}$ is used as the DMA write strobe during DMA operations from a 16-bit PC Card that supports DMA. The PCI1451A device asserts $\overline{\text{IOWR}}$ during transfers from host memory to the PC Card.
$\overline{\text{OE}}$	B5	F19	O	Output enable. $\overline{\text{OE}}$ is driven low by the PCI1451A device to enable 16-bit memory PC Card data output during host memory read cycles. DMA terminal count. $\overline{\text{OE}}$ is used as terminal count (TC) during DMA operations to a 16-bit PC Card that supports DMA. The PCI1451A device asserts $\overline{\text{OE}}$ to indicate TC for a DMA write operation.

† Terminal name for slot A is preceded with A_. For example, the full name for terminal B5 is A_ $\overline{\text{OE}}$.

‡ Terminal name for slot B is preceded with B_. For example, the full name for terminal F19 is B_ $\overline{\text{OE}}$.

Table 2–14. 16-Bit PC Card Interface Control Terminals (slots A and B) (Continued)

TERMINAL			I/O	FUNCTION
NAME	NO.			
	SLOT A†	SLOT B‡		
READY (IREQ)	K2	E11	I	Ready. The ready function is provided by READY when the 16-bit PC Card and the host socket are configured for the memory-only interface. READY is driven low by the 16-bit memory PC Cards to indicate that the memory card circuits are busy processing a previous write command. READY is driven high when the 16-bit memory PC Card is ready to accept a new data-transfer command. Interrupt request. IREQ is asserted by a 16-bit I/O PC Card to indicate to the host that a device on the 16-bit I/O PC Card requires service by the host software. IREQ is high (deasserted) when no interrupt is requested.
REG	J2	A12	O	Attribute memory select. REG remains high for all common memory accesses. When REG is asserted, access is limited to attribute memory (OE or WE active) and to the I/O space (IORD or IOWR active). Attribute memory is a separately accessed section of card memory and generally is used to record card capacity and other configuration and attribute information. DMA acknowledge. REG is used as a DMA acknowledge (DACK) during DMA operations to a 16-bit PC Card that supports DMA. The PCI1451A device asserts REG to indicate a DMA operation. REG is used in conjunction with the DMA read (IOWR) or DMA write (IORD) strobes to transfer data.
RESET	H2	F13	O	PC Card reset. RESET forces a hard reset to a 16-bit PC Card.
VS1 VS2	K1 H6	B11 A14	I/O	Voltage sense 1 and voltage sense 2. VS1 and VS2, when used in conjunction with each other, determine the operating voltage of the 16-bit PC Card.
WAIT	K4	F11	I	Bus cycle wait. WAIT is driven by a 16-bit PC Card to extend the completion of the memory or I/O cycle in progress.
WE	E4	B18	O	Write enable. WE is used to strobe memory write data into 16-bit memory PC Cards. WE also is used for memory PC Cards that employ programmable memory technologies. DMA terminal count. WE is used as TC during DMA operations to a 16-bit PC Card that supports DMA. The PCI1451A device asserts WE to indicate TC for a DMA read operation.
WP (IOIS16)	L2	B10	I	Write protect. WP applies to 16-bit memory PC Cards. WP reflects the status of the write-protect switch on 16-bit memory PC Cards. For 16-bit I/O cards, WP is used for the 16-bit port (IOIS16) function. I/O is 16 bits. IOIS16 applies to 16-bit I/O PC Cards. IOIS16 is asserted by the 16-bit PC Card when the address on the bus corresponds to an address to which the 16-bit PC Card responds, and the I/O port that is addressed is capable of 16-bit accesses. DMA request. WP can be used as the DMA request signal during DMA operations to a 16-bit PC Card that supports DMA. If used, the PC Card asserts WP to indicate a request for a DMA operation.

† Terminal name for slot A is preceded with A_. For example, the full name for terminal E4 is A_WE.

‡ Terminal name for slot B is preceded with B_. For example, the full name for terminal B18 is B_WE.

Table 2–15. CardBus PC Card Interface System Terminals (slots A and B)

TERMINAL			I/O	FUNCTION
NAME	NO.			
	SLOT A†	SLOT B‡		
CCLK	E2	A17	O	CardBus PC Card clock. CCLK provides synchronous timing for all transactions on the CardBus interface. All signals except CRST, CCLKRUN, CINT, CSTSCHG, CAUDIO, CCD2, CCD1, CVS2, and CVS1 are sampled on the rising edge of CCLK, and all timing parameters are defined with the rising edge of this signal. CCLK operates at the PCI bus clock frequency, but it can be stopped in the low state or slowed down for power savings.
CCLKRUN	L2	B10	O	CardBus PC Card clock run. CCLKRUN is used by a CardBus PC Card to request an increase in the CCLK frequency, and by the PCI1451A device to indicate that the CCLK frequency is decreased. CardBus clock run (CCLKRUN) follows the PCI clock run (CLKRUN).
CRST	H2	F13	I/O	CardBus PC Card reset. CRST brings CardBus PC Card-specific registers, sequencers, and signals to a known state. When CRST is asserted, all CardBus PC Card signals must be placed in a high-impedance state, and the PCI1451A device drives these signals to a valid logic level. Assertion can be asynchronous to CCLK, but deassertion must be synchronous to CCLK.

† Terminal name for slot A is preceded with A_. For example, the full name for terminal E2 is A_CCLK.

‡ Terminal name for slot B is preceded with B_. For example, the full name for terminal A17 is B_CCLK.

Table 2–16. CardBus PC Card Address and Data Terminals (slots A and B)

TERMINAL			I/O	FUNCTION
NAME	NO.			
	SLOT A†	SLOT B‡		
CAD31	N7	E9	I/O	PC Card address and data. These signals make up the multiplexed CardBus address and data bus on the CardBus interface. During the address phase of a CardBus cycle, CAD31–CAD0 contain a 32-bit address. During the data phase of a CardBus cycle, CAD31–CAD0 contain data. CAD31 is the most significant bit.
CAD30	M4	B9		
CAD29	M1	A9		
CAD28	M6	F9		
CAD27	L5	E10		
CAD26	K6	D11		
CAD25	J6	E12		
CAD24	J5	D12		
CAD23	J1	D13		
CAD22	H5	B13		
CAD21	H4	E13		
CAD20	H1	B14		
CAD19	G4	E14		
CAD18	G2	B15		
CAD17	G5	A15		
CAD16	B3	E16		
CAD15	B4	F14		
CAD14	D4	E18		
CAD13	D5	F16		
CAD12	A4	F15		
CAD11	B5	F19		
CAD10	A5	G14		
CAD9	F6	G15		
CAD8	A6	G18		
CAD7	F7	G13		
CAD6	B7	H18		
CAD5	D7	H16		
CAD4	G7	H14		
CAD3	A7	H19		
CAD2	B8	J16		
CAD1	E8	J15		
CAD0	A8	J18		
CC/ $\overline{\text{BE}}3$ CC/ $\overline{\text{BE}}2$ CC/ $\overline{\text{BE}}1$ CC/ $\overline{\text{BE}}0$	J2 G6 A2 D6	A12 E15 D19 G16	I/O	CardBus bus commands and byte enables. CC/ $\overline{\text{BE}}3$ –CC/ $\overline{\text{BE}}0$ are multiplexed on the same CardBus terminals. During the address phase of a CardBus cycle, CC/ $\overline{\text{BE}}3$ –CC/ $\overline{\text{BE}}0$ define the bus command. During the data phase, this 4-bit bus is used as byte enables. The byte enables determine which byte paths of the full 32-bit data bus carry meaningful data. CC/ $\overline{\text{BE}}0$ applies to byte 0 (CAD7–CAD0), CC/ $\overline{\text{BE}}1$ applies to byte 1 (CAD15–CAD8), CC/ $\overline{\text{BE}}2$ applies to byte 2 (CAD23–CAD16), and CC/ $\overline{\text{BE}}3$ applies to byte 3 (CAD31–CAD24).
CPAR	B1	C19	I/O	CardBus parity. In all CardBus read and write cycles, the PCI1451A device calculates even parity across the CAD and CC/ $\overline{\text{BE}}$ buses. As an initiator during CardBus cycles, the PCI1451A device outputs CPAR with a one-CCLK delay. As a target during CardBus cycles, the calculated parity is compared to the initiator's parity indicator; a compare error results in a parity-error assertion.

† Terminal name for slot A is preceded with A_. For example, the full name for terminal B1 is A_CPAR.

‡ Terminal name for slot B is preceded with B_. For example, the full name for terminal C19 is B_CPAR.

Table 2–17. CardBus PC Card Interface Control Terminals (slots A and B)

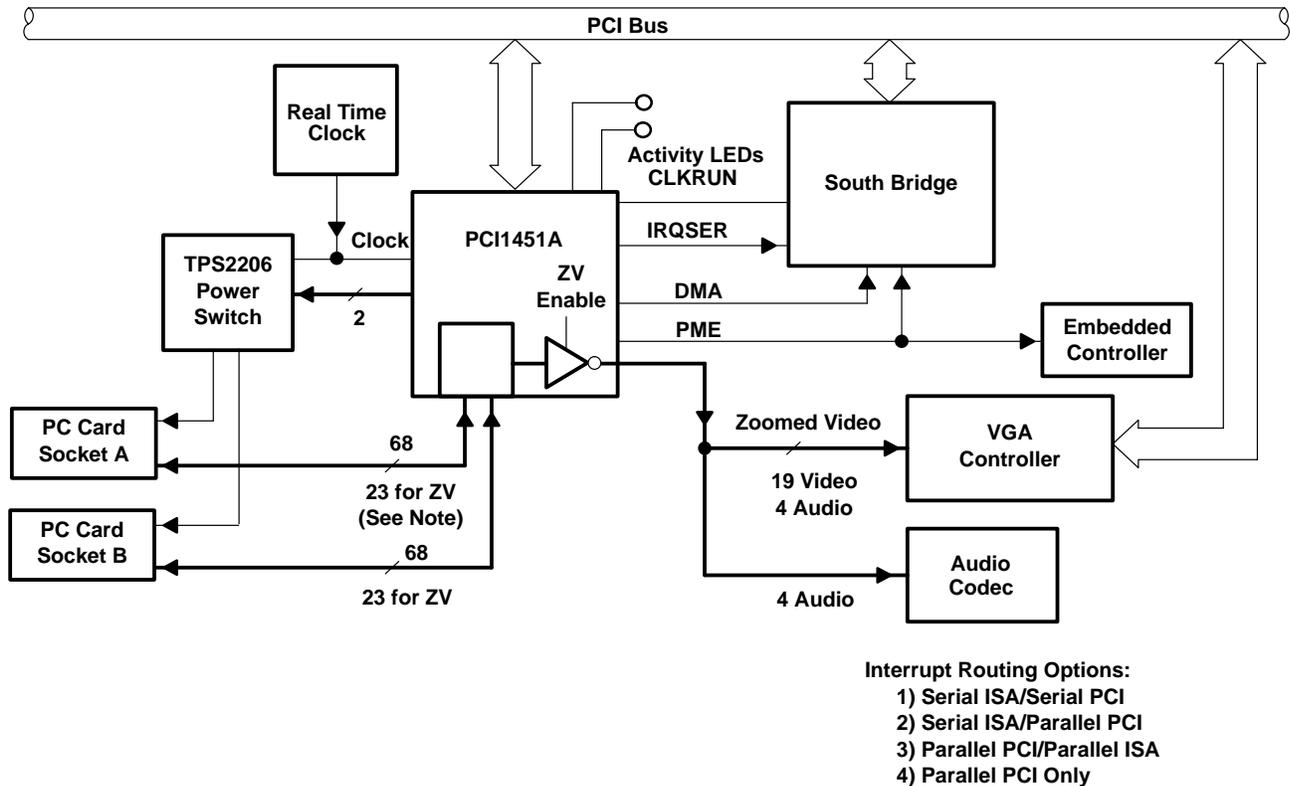
TERMINAL			I/O	FUNCTION
NAME	NO.			
	SLOT A†	SLOT B‡		
CAUDIO	L6	F10	I	CardBus audio. CAUDIO is a digital input signal from a PC Card to the system speaker. The PCI1451A device supports the binary audio mode and outputs a binary signal from the card to SPKROUT.
CBLOCK	C2	D16	I/O	CardBus lock. CBLOCK is used to gain exclusive access to a target.
CCD1 CCD2	F8 L4	J19 D10	I	CardBus detect 1 and CardBus detect 2. CCD1 and CCD2 are used in conjunction with CVS1 and CVS2 to identify card insertion and interrogate cards to determine the operating voltage and card type.
CDEVSEL	E5	A18	I/O	CardBus device select. The PCI1451A device asserts CDEVSEL to claim a CardBus cycle as the target device. As a CardBus initiator on the bus, the PCI1451A device monitors CDEVSEL until a target responds. If no target responds before time-out occurs, the PCI1451A device terminates the cycle with an initiator abort.
CFRAME	F2	D15	I/O	CardBus cycle frame. CFRAME is driven by the initiator of a CardBus bus cycle. CFRAME is asserted to indicate that a bus transaction is beginning, and data transfers continue while this signal is asserted. When CFRAME is deasserted, the CardBus bus transaction is in the final data phase.
CGNT	E4	B18	I	CardBus bus grant. CGNT is driven by the PCI1451A device to grant a CardBus PC Card access to the CardBus bus after the current data transaction has been completed.
CINT	K2	E11	I	CardBus interrupt. CINT is asserted low by a CardBus PC Card to request interrupt servicing from the host.
CIRDY	F4	B16	I/O	CardBus initiator ready. CIRDY indicates the CardBus initiator's ability to complete the current data phase of the transaction. A data phase is completed on a rising edge of CCLK when both CIRDY and CTRDY are asserted. Until both CIRDY and CTRDY are sampled asserted, wait states are inserted.
CPERR	D1	C18	I/O	CardBus parity error. CPERR reports parity errors during CardBus transactions, except during special cycles. It is driven low by a target two clocks following that data when a parity error is detected.
CREQ	J4	A13	I	CardBus request. CREQ indicates to the arbiter that the CardBus PC Card desires use of the CardBus bus as an initiator.
CSERR	K4	F11	I	CardBus system error. CSERR reports address parity errors and other system errors that could lead to catastrophic results. CSERR is driven by the card synchronous to CCLK, but deasserted by a weak pullup, and may take several CCLK periods. The PCI1451A device can report CSERR to the system by assertion of SERR on the PCI interface.
CSTOP	D2	B19	I/O	CardBus stop. CSTOP is driven by a CardBus target to request the initiator to stop the current CardBus transaction. CSTOP is used for target disconnects, and is commonly asserted by target devices that do not support burst data transfers.
CSTSCHG	L1	A10	I	CardBus status change. CSTSCHG alerts the system to a change in the card's status and is used as a wake-up mechanism.
CTRDY	F5	B17	I/O	CardBus target ready. CTRDY indicates the CardBus target's ability to complete the current data phase of the transaction. A data phase is completed on a rising edge of CCLK, when both CIRDY and CTRDY are asserted; until this time, wait states are inserted.
CVS1 CVS2	K1 H6	B11 A14	I/O	CardBus voltage sense 1 and CardBus voltage sense 2. CVS1 and CVS2 are used in conjunction with CCD1 and CCD2 to identify card insertion and interrogate cards to determine the operating voltage and card type.

† Terminal name for slot A is preceded with A_. For example, the full name for terminal L6 is A_CAUDIO.

‡ Terminal name for slot B is preceded with B_. For example, the full name for terminal F10 is B_CAUDIO.

3 Feature/Protocol Descriptions

Figure 3–1 shows a simplified system implementation example using the PCI1451A device. The PCI interface includes all address/data and control signals for PCI protocol. Highlighted in this diagram is the functionality supported by the PCI1451A device. The PCI1451A device supports PC/PCI DMA, PCI Way DMA (distributed DMA), PME wake-up from D3_{Cold} through D0, 4 interrupt modes, an integrated zoomed-video (ZV) port, and 12 multifunction terminals (8 MFUNC and 4 GPIO terminals) that can be programmed for a wide variety of functions.



NOTE: The PC Card interface is 68 pins for CardBus and 16-bit PC Cards. In ZV mode, 23 pins are used for routing the ZV signals to the VGA controller and audio subsystem.

Figure 3–1. PCI1451A System Block Diagram

3.1 I/O Characteristics

Figure 3–2 shows a 3-state bidirectional buffer. Section 8.2, *Recommended Operating Conditions*, provides the electrical characteristics of the inputs and outputs. The PCI1451A device meets the ac specifications of the *PC Card Standard* and the *PCI Local Bus Specification*.

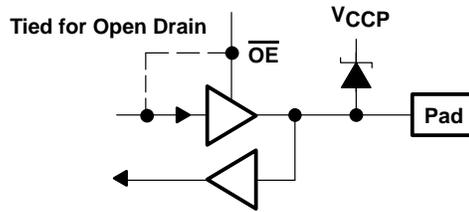


Figure 3–2. 3-State Bidirectional Buffer

3.2 Clamping Voltages

The I/O sites can be pulled through a clamping diode to a voltage rail for protection. The 3.3-V core power supply is independent of the clamping voltages. The clamping (protection) diodes are required if the signaling environment on an I/O is system dependent. For example, PCI signaling can be either 3.3 Vdc or 5 Vdc, and the PCI1451A device must reliably accommodate both voltage levels. This is accomplished by using a 3.3-V buffer with a clamping diode to V_{CCP} . If a system design requires a 5-V PCI bus, the V_{CCP} is connected to the 5-V power supply.

A standard die has only one clamping voltage for the sites as shown in Figure 3–2. After the terminal assignments are fixed, the fabrication facility supports a design by splitting the clamping voltage for customization. The PCI1451A device requires three separate clamping voltages since it supports a wide range of features. The three voltages are listed and defined in Section 8.2, *Recommended Operating Conditions*.

3.3 Peripheral Component Interconnect (PCI) Interface

This section describes the PCI interface of the PCI1451A device, and how the device responds to and participates in PCI bus cycles. The PCI1451A device provides all required signals for PCI master/slave devices and can operate in either 5-V or 3.3-V PCI signaling environments by connecting the V_{CCP} terminals to the desired voltage level.

3.3.1 PCI Bus Lock (\overline{LOCK})

The bus locking protocol defined in the *PCI Local Bus Specification* is not highly recommended, but is provided on the PCI1451A device as an additional compatibility feature. The PCI \overline{LOCK} terminal is multiplexed with GPIO2, and the terminal function defaults to a general-purpose input (GPI). The use of \overline{LOCK} is supported only by PCI-to-CardBus bridges in the downstream direction (away from the processor).

PCI \overline{LOCK} indicates an atomic operation that may require multiple transactions to complete. When \overline{LOCK} is asserted, nonexclusive transactions may proceed to an address that currently is not locked. A grant to start a transaction on the PCI bus does not guarantee control of \overline{LOCK} ; control of \overline{LOCK} is obtained under its own protocol. It is possible for different initiators to use the PCI bus while a single master retains ownership of \overline{LOCK} . To avoid confusion with the PCI bus clock, the CardBus signal for this protocol is \overline{CBLOCK} .

An agent may need to do an exclusive operation because a critical access to memory might be broken into several transactions, but the master wants exclusive rights to a region of memory. The granularity of the lock is defined by PCI to be 16 bytes, aligned. The \overline{LOCK} protocol defined by the *PCI Local Bus Specification* allows a resource lock without interfering with nonexclusive, real-time data transfer, such as video.

The PCI bus arbiter may be designed to support only complete bus locks using the \overline{LOCK} protocol. In this scenario the arbiter will not grant the bus to any other agent (other than the \overline{LOCK} master) while \overline{LOCK} is asserted. A complete bus lock may have a significant impact on the performance of the video. The arbiter that supports complete bus lock must grant the bus to the cache to perform a writeback due to a snoop to a modified line when a locked operation is in progress.

The PCI1451A device supports all \overline{LOCK} protocol associated with PCI-to-PCI bridges, as also defined for PCI-to-CardBus bridges. This includes disabling write posting while a locked operation is in progress, which can solve a potential deadlock when using devices such as PCI-to-PCI bridges. The potential deadlock can occur if a CardBus

target supports delayed transactions and blocks access as the target until it completes a delayed read. This target characteristic is prohibited by the *PCI Local Bus Specification*, and the issue is resolved by the PCI master using **LOCK**.

3.3.2 Loading the Subsystem Identification (EEPROM Interface)

The subsystem vendor ID register (PCI offset 40h, see Section 4.26) and subsystem ID register (PCI offset 42h, see Section 4.27) make up a doubleword of PCI configuration space located at offset 40h for functions 0 and 1. This doubleword register is used for system and option card (mobile dock) identification purposes, and is required by some operating systems.

The PCI1451A device offers two mechanisms to load a read-only value into the subsystem registers. The first mechanism relies upon the system BIOS providing the subsystem ID value. The default access mode to the subsystem registers is read-only, but the access mode can be made read/write by clearing bit 5 (SUBSYSRW) in the system control register (PCI offset 80h, see Section 4.29). When this bit is cleared (0), the BIOS can write a subsystem identification value into the registers at PCI offset 40h. The BIOS must set the SUBSYSRW bit such that the subsystem vendor ID register and subsystem ID register are limited to read-only access. This approach saves the added cost of implementing the serial electrically erasable programmable ROM (EEPROM).

In some conditions, such as in a docking environment, the subsystem vendor ID register and subsystem ID register must be loaded with a unique identifier through a serial EEPROM interface. The PCI1451A device loads the doubleword of data from the serial EEPROM after a reset of the primary bus. The $\overline{\text{SUSPEND}}$ input gates the $\overline{\text{PRST}}$ and $\overline{\text{GRST}}$ from the entire PCI1451A core, including the serial EEPROM state machine (see Section 3.6.7, *Suspend Mode*, for details on using $\overline{\text{SUSPEND}}$). The PCI1451A device provides a two-line serial bus interface to the serial EEPROM.

The system designer must implement a pullup resistor on the PCI1451A SDA terminal to indicate the serial EEPROM mode. Only when this pullup resistor is present will the PCI1451A device attempt to load data through the serial EEPROM interface. Note that a pullup resistor is also required on the SCL terminal to implement the EEPROM interface correctly. The serial EEPROM interface is a two-pin interface with one data signal (SDA) and one clock signal (SCL). Figure 3–3 illustrates a typical PCI1451A application using the serial EEPROM interface.

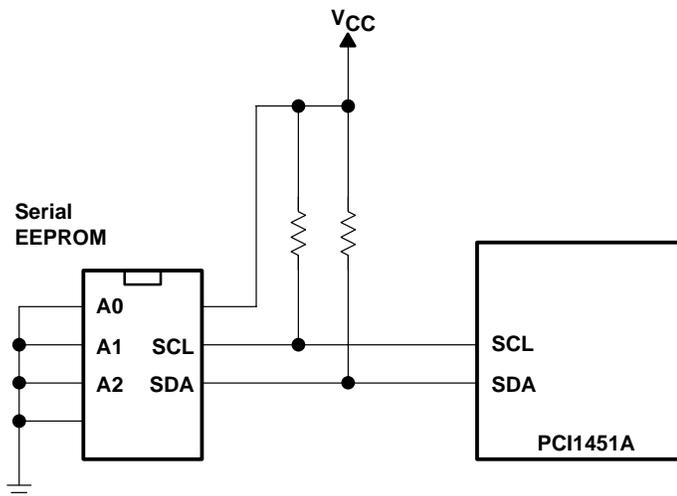


Figure 3–3. Serial EEPROM Application

As stated above, when the PCI1451A device is reset by $\overline{\text{GRST}}$, the subsystem data is read automatically from the EEPROM. The PCI1451A device masters the serial EEPROM bus and reads four bytes as described in Figure 3–4.

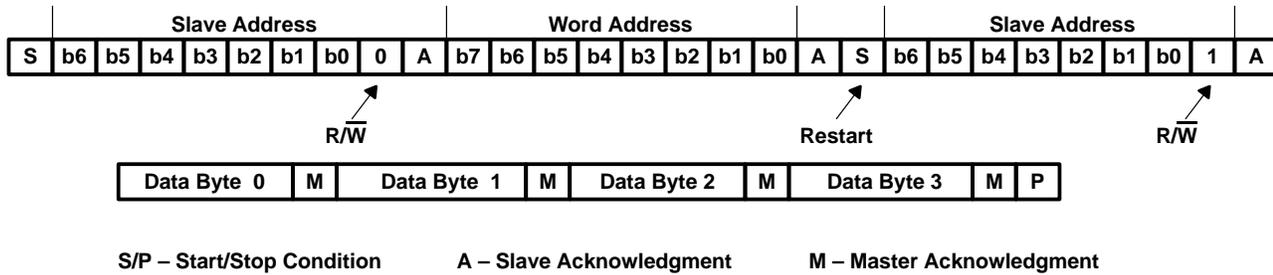


Figure 3-4. EEPROM Interface Subsystem Data Collection

The EEPROM is addressed at word address 00h, as indicated in Figure 3-4, and the address autoincrements after each byte transfers according to the protocol. Thus, to provide the subsystem register with data AABBCDDh the EEPROM should be programmed with address 0 = AAh, 1 = BBh, 2 = CCh, and 3 = DDh.

The serial EEPROM is addressed at slave address 1010 000b by the PCI1451A device. All hardware address bits for the EEPROM should be tied to the appropriate level to achieve this address. The serial EEPROM chip in the sample application circuit, Figure 3-3, assumes the 1010b high address nibble. The lower three address bits are terminal inputs to the chip, and the sample application shows these terminal inputs tied to GND.

The serial EEPROM interface signals require pullup resistors. The serial EEPROM protocol allows bidirectional transfers. Both the SCL and SDA signals are placed in a high-impedance state and pulled high when the bus is not active. When the SDA line transitions to a logic low, this signals a start condition (S). A low-to-high transition of SDA while SCL is high is defined as the stop condition (P). One bit is transferred during each clock pulse. The data on the SDA line must remain stable during the high period of the clock pulse, as changes in the data line at this time are interpreted as a control signal. Data is valid and stable during the clock high period. Figure 3-5 illustrates this protocol.

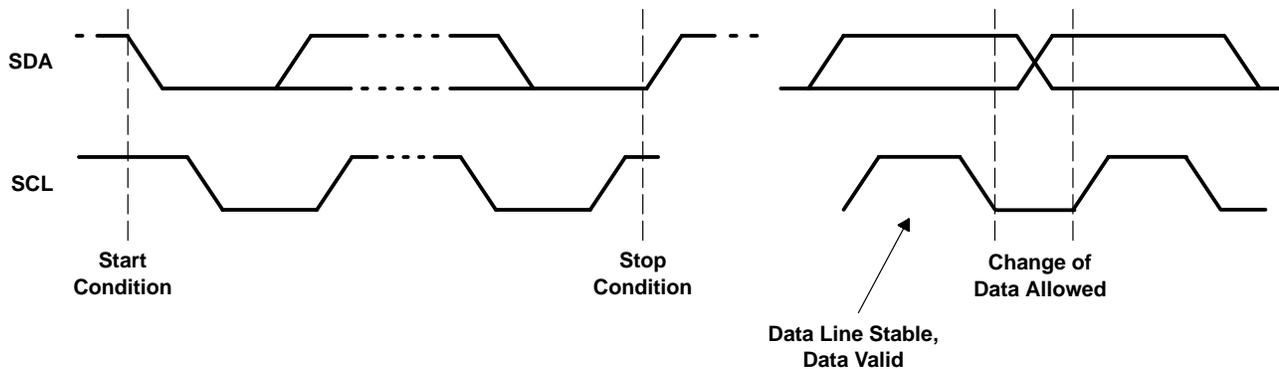


Figure 3-5. Serial EEPROM Start/Stop Conditions and Bit Transfers

Each address byte and data transfer is followed by an acknowledge bit, as indicated in Figure 3-4. When the PCI1451A device transmits the addresses, it returns the SDA signal to the high state and places the line in a high-impedance state. The PCI1451A device then generates an SCL clock cycle and expects the EEPROM to pull down the SDA line during the acknowledge pulse. This procedure is referred to as a slave acknowledge with the PCI1451A transmitter and the EEPROM receiver. Figure 3-6 illustrates general acknowledges.

During the data byte transfers from the serial EEPROM to the PCI1451A device, the EEPROM clocks the SCL signal. After the EEPROM transmits the data to the PCI1451A device, it returns the SDA signal to the high state and places the line in a high-impedance state. The EEPROM then generates an SCL clock cycle and expects the PCI1451A device to pull down the SDA line during the acknowledge pulse. This procedure is referred to as a master acknowledge with the EEPROM transmitter and the PCI1451A receiver. Figure 3-6 illustrates general acknowledges.

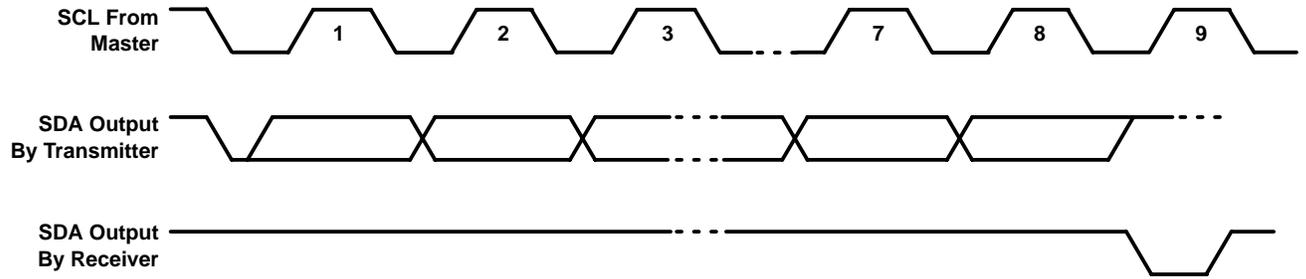


Figure 3–6. Serial EEPROM Protocol – Acknowledge

EEPROM interface status information is communicated through the general status register (PCI offset 85h, see Section 4.31). Bit 2 (EEDTECT) in this register indicates whether or not the PCI1451A serial EEPROM circuitry detects the pullup resistor on SDA. An error condition, such as a missing acknowledge, results in bit 1 (DATAERR) being set. Bit 0 (EEBUSY) is set while the subsystem ID register is loading (serial EEPROM interface is busy).

3.3.3 Serial Bus EEPROM Application

When the PCI bus is reset and the serial bus interface is detected, the PCI1451A device attempts to read the subsystem identification and other register defaults from a serial EEPROM. The registers and corresponding bits that may be loaded with defaults through the EEPROM are provided in Table 3–1.

Table 3–1. Registers and Bits Loadable Through Serial EEPROM

PCI OFFSET	EEPROM OFFSET REFERENCE	REGISTER NAME	BITS LOADED FROM EEPROM TO CORRESPONDING BITS IN REGISTER
PCI 43h	21h	Subsystem ID (see Section 4.27)	Byte 1
PCI 42h	22h	Subsystem ID (see Section 4.27)	Byte 0
PCI 41h	23h	Subsystem vendor ID (see Section 4.26)	Byte 1
PCI 40h	24h	Subsystem vendor ID (see Section 4.26)	Byte 0
PCI 80h	25h	System control (see Section 4.29)	Byte 0, bits 6, 5, 4, 3, 1, 0
PCI 81h	26h	System control (see Section 4.29)	Byte 1, bits 7, 6
PCI 82h	27h	System control (see Section 4.29)	Byte 2, bits 6–0
PCI 83h	28h	System control (see Section 4.29)	Byte 3, bits 7, 6, 5, 3, 2, 0
PCI 86h	29h	Reserved	No bits loaded
PCI 89h	2Ah	General-purpose event enable (see Section 4.33)	Bits 7, 6, 3, 2, 1, 0
PCI 8Bh	2Bh	General-purpose output (see Section 4.35)	Bits 3–0
PCI 8Ch	2Ch	Multifunction routing status (see Section 4.36)	Byte 0
PCI 8Dh	2Dh	Multifunction routing status (see Section 4.36)	Byte 1
PCI 8Eh	2Eh	Multifunction routing status (see Section 4.36)	Byte 2
PCI 8Fh	2Fh	Multifunction routing status (see Section 4.36)	Byte 3
PCI 91h	30h	Card control (see Section 4.38)	Bits 7, 2, 1
PCI 92h	31h	Device control (see Section 4.39)	Bits 7–0
PCI 93h	32h	Diagnostic (see Section 4.40)	Bits 7, 4–0
PCI A2h	33h	Power management capabilities (see Section 4.45)	Bit 15
ExCA 00h	34h	ExCA identification and revision (see Section 5.1)	Bits 7–0

Figure 3–7 details the EEPROM data format. This format must be followed for the PCI1451A device to load initializations properly from a serial EEPROM. Any undefined condition results in a terminated load and sets bit 1 (DATAERR) in the general status register (PCI offset 85h, see Section 4.31).

Slave Address = 1010 0000b

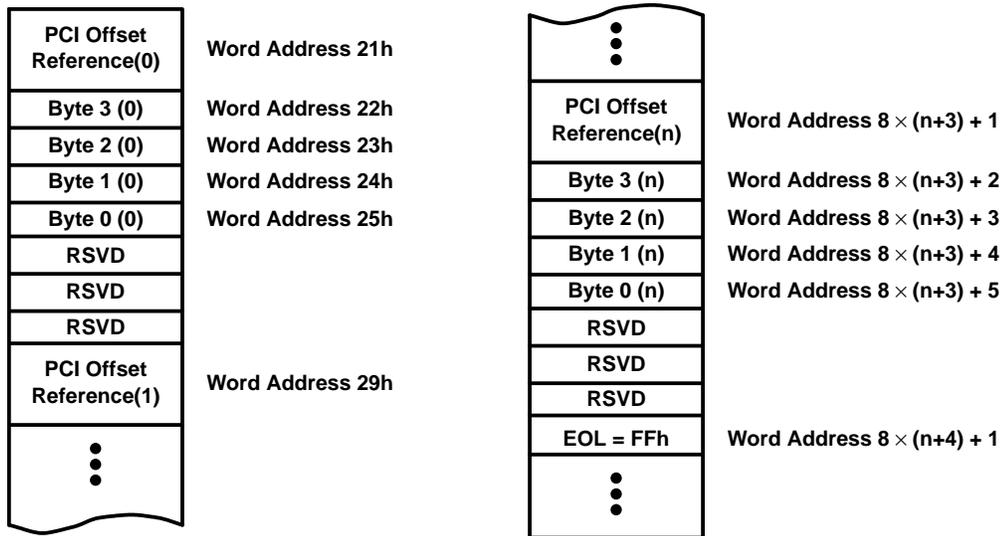


Figure 3–7. EEPROM Data Format

The byte at EEPROM word address 00h must contain either a valid PCI offset, as listed in Table 3–1, or an end-of-list (EOL) indicator. The EOL indicator is a byte value of FFh, and indicates the end of the data to load from the EEPROM. Only doubleword registers are loaded from the EEPROM, and all bit fields must be considered when programming the EEPROM.

The serial EEPROM is addressed at slave address 1010 000b by the PCI1451A device. All hardware address bits for the EEPROM should be tied to the appropriate level to achieve this address. The serial EEPROM chip in the sample application circuit (Figure 3–3) assumes the 1010b high-address nibble. The lower three address bits are terminal inputs to the chip, and the sample application shows these terminal inputs tied to GND.

When a valid offset reference is read, four bytes are read from the EEPROM, MSB first, as illustrated in Figure 3–4. The address autoincrements after every byte transfer according to the doubleword read protocol. Note that the word addresses align with the data format illustrated in Figure 3–7. The PCI1451A device continues to load data from the serial EEPROM until an end-of-list indicator is read. Three reserved bytes are stuffed to maintain 8-byte data structures.

Note that the 8-byte data structure is important to provide correct addressing per the doubleword read format shown in Figure 3–4. In addition, the reference offsets must be loaded in the EEPROM in sequential order, that is, 01h, 02h, 03h, 04h. If the offsets are not sequential, the registers may be loaded incorrectly.

3.4 PC Card Applications Overview

This section describes the PC Card interfaces of the PCI1451A device. A discussion on PC Card recognition details the card interrogation procedure. The card powering procedure is also discussed, including the protocol of the P²C power-switch interface. The internal ZV buffering provided by the PCI1451A device and programming model is also detailed. Also, standard PC Card register models are described, as well as a brief discussion of the PC Card software protocol layers.

3.4.1 PC Card Insertion/Removal and Recognition

The *PC Card Standard* addresses the card detection and recognition process through an interrogation procedure that the socket must initiate upon card insertion into a cold, unpowered socket. Through this interrogation, card voltage requirements and interface (16-bit versus CardBus) are determined.

The scheme uses the $\overline{CD1}$, $\overline{CD2}$, $\overline{VS1}$, and $\overline{VS2}$ signals ($\overline{CCD1}$, $\overline{CCD2}$, $\overline{CVS1}$, $\overline{CVS2}$ for CardBus). A PC Card designer connects these four pins in a certain configuration depending on the type of card and the supply voltage. The encoding scheme for this, defined in the *PC Card Standard*, is shown in Table 3–2.

Table 3–2. PC Card – Card Detect and Voltage Sense Connections

$\overline{CD2//CCD2}$	$\overline{CD1//CCD1}$	$\overline{VS2//CVS2}$	$\overline{VS1//CVS1}$	Key	Interface	Voltage
Ground	Ground	Open	Open	5 V	16-bit PC Card	5 V
Ground	Ground	Open	Ground	5 V	16-bit PC Card	5 V and 3.3 V
Ground	Ground	Ground	Ground	5 V	16-bit PC Card	5 V, 3.3 V, and X.X V
Ground	Ground	Open	Ground	LV	16-bit PC Card	3.3 V
Ground	Connect to CVS1	Open	Connect to $\overline{CCD1}$	LV	CardBus PC Card	3.3 V
Ground	Ground	Ground	Ground	LV	16-bit PC Card	3.3 V and X.X V
Connect to CVS2	Ground	Connect to $\overline{CCD2}$	Ground	LV	CardBus PC Card	3.3 V and X.X V
Connect to CVS1	Ground	Ground	Connect to $\overline{CCD2}$	LV	CardBus PC Card	3.3 V, X.X V, and Y.Y V
Ground	Ground	Ground	Open	LV	16-bit PC Card	Y.Y V
Connect to CVS2	Ground	Connect to $\overline{CCD2}$	Open	LV	CardBus PC Card	Y.Y V
Ground	Connect to CVS2	Connect to $\overline{CCD1}$	Open	LV	CardBus PC Card	X.X V and Y.Y V
Connect to CVS1	Ground	Open	Connect to $\overline{CCD2}$	LV	CardBus PC Card	Y.Y V
Ground	Connect to CVS1	Ground	Connect to $\overline{CCD1}$		Reserved	
Ground	Connect to CVS2	Connect to $\overline{CCD1}$	Ground		Reserved	

3.4.2 P²C Power-Switch Interface (TPS2202A/2206)

A power switch with a PCMCIA peripheral-control (P²C) interface is required for the PC Card powering interface. The TI TPS2206 (or TPS2202A) dual-slot PC Card power-switch interface provides the P²C interface to the CLOCK, DATA, and LATCH terminals of the PCI1451A device. Figure 3–8 shows the terminal assignments of the TPS2206 power-switch interface. Figure 3–9 illustrates a typical application where the PCI1451A device represents the PCMCIA controller.

There are two ways to provide a clock source to the power-switch interface. The first method is to provide an external clock source such as a 32-kHz real-time clock to the CLOCK terminal. The second method is to use the internal ring oscillator. If the internal ring oscillator is used, the PCI1451A device provides its own clock source for the PC Card interrogation logic and the power-switch interface. The mode of operation is determined by the setting of bit 27 (P2CCLK) of the system control register (PCI offset 80h, see Section 4.29). This bit is encoded as follows:

0 = CLOCK terminal is an input (default).

1 = CLOCK terminal is an output that utilizes the internal oscillator.

A 43-k Ω pulldown resistor should be tied to the CLOCK terminal.

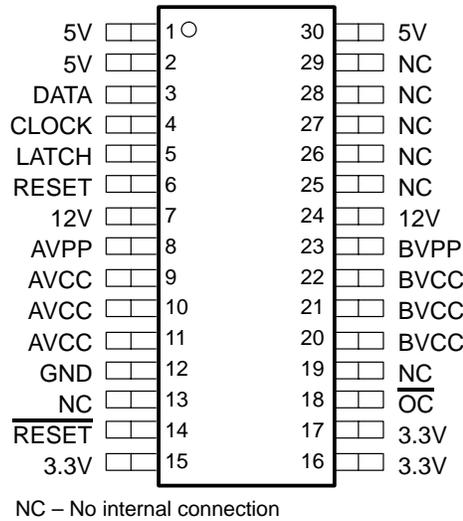


Figure 3–8. TPS2206 Terminal Assignments

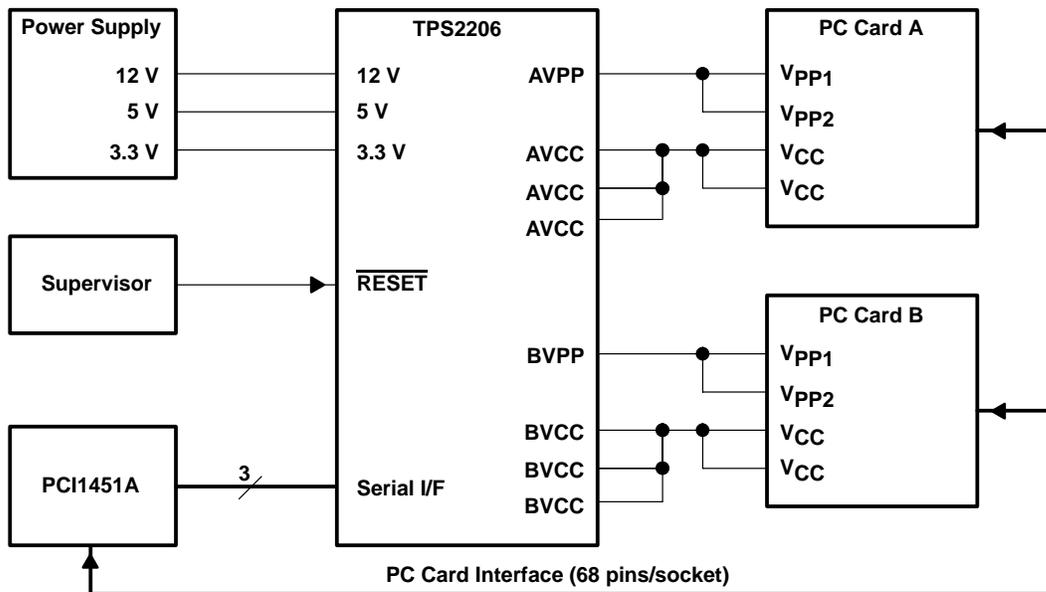
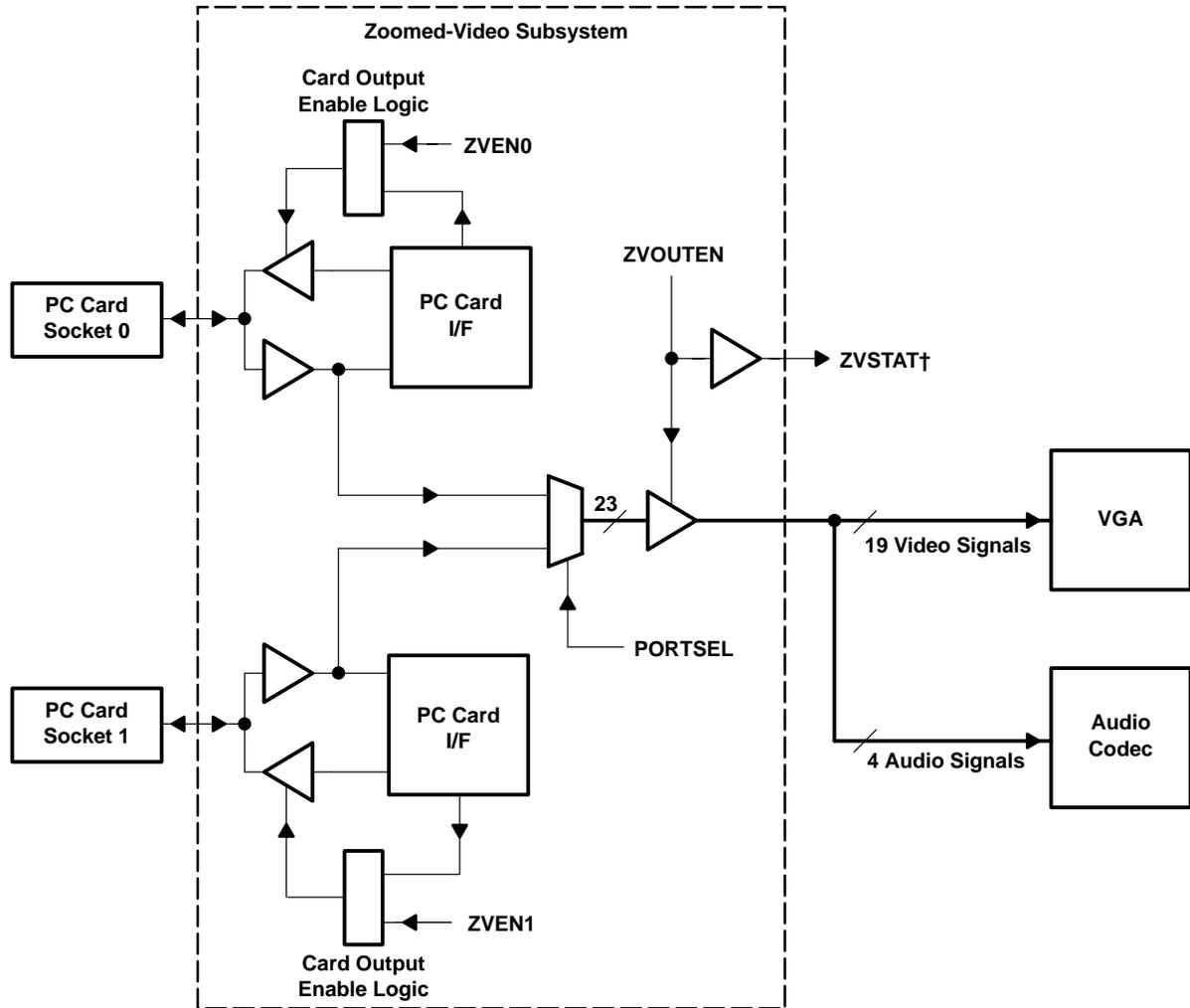


Figure 3–9. TPS2206 Typical Application

3.4.3 Zoomed-Video Support

The ZV port on the PCI1451A device provides an internally buffered 16-bit ZV PC Card data path. This internal routing is programmed through the multimedia control register (PCI offset 84h, see Section 4.30). Figure 3–10 summarizes the ZV subsystem implemented in the PCI1451A device, and details the bit functions found in the multimedia control register (PCI offset 84h, see Section 4.30).

An output port (PORTSEL) is always selected. The PCI1451A device defaults to socket 0 (see the multimedia control register). When ZVOUTEN is enabled, the ZV output terminals are enabled and allow the PCI1451A device to route the ZV data. However, no data is transmitted unless either bit 0 (ZVEN0) or bit 1 (ZVEN1) is enabled in the multimedia control register (PCI offset 84h, see Section 4.30). If the PORTSEL maps to a card port that is disabled (ZVEN0 = 0 or ZVEN1 = 0), the ZV port is driven low (that is, no data is transmitted).



† ZVSTAT must be enabled through the GPIO control register.

Figure 3–10. Zoomed-Video Subsystem

3.4.4 Zoomed-Video Autodetect

Zoomed-video autodetect, when enabled, allows the PCI1451A device to automatically detect ZV data by sensing the pixel clock from each socket and/or from a third ZV source that may exist on the motherboard. The PCI1451A device automatically switches the internal ZV MUX to route the ZV stream to the ZV output port of the PCI1451A device. This eliminates the need for software to switch the internal MUX using bits 6 and 7 of the multimedia control register (PCI offset 84h, see Section 4.30).

The PCI1451A device can be programmed to switch a third ZV source by programming MFUNC2 or MFUNC3 as a ZV pixel clock sense pin and connecting this pin to the pixel clock of the third ZV source. ZVSTAT may then be programmed onto MFUNC4, MFUNC1, or MFUNC0 and this signal may switch the ZV buffers from the third ZV source. To account for the possibility of several ZV sources being enabled at the same time, a programmable priority scheme may be enabled.

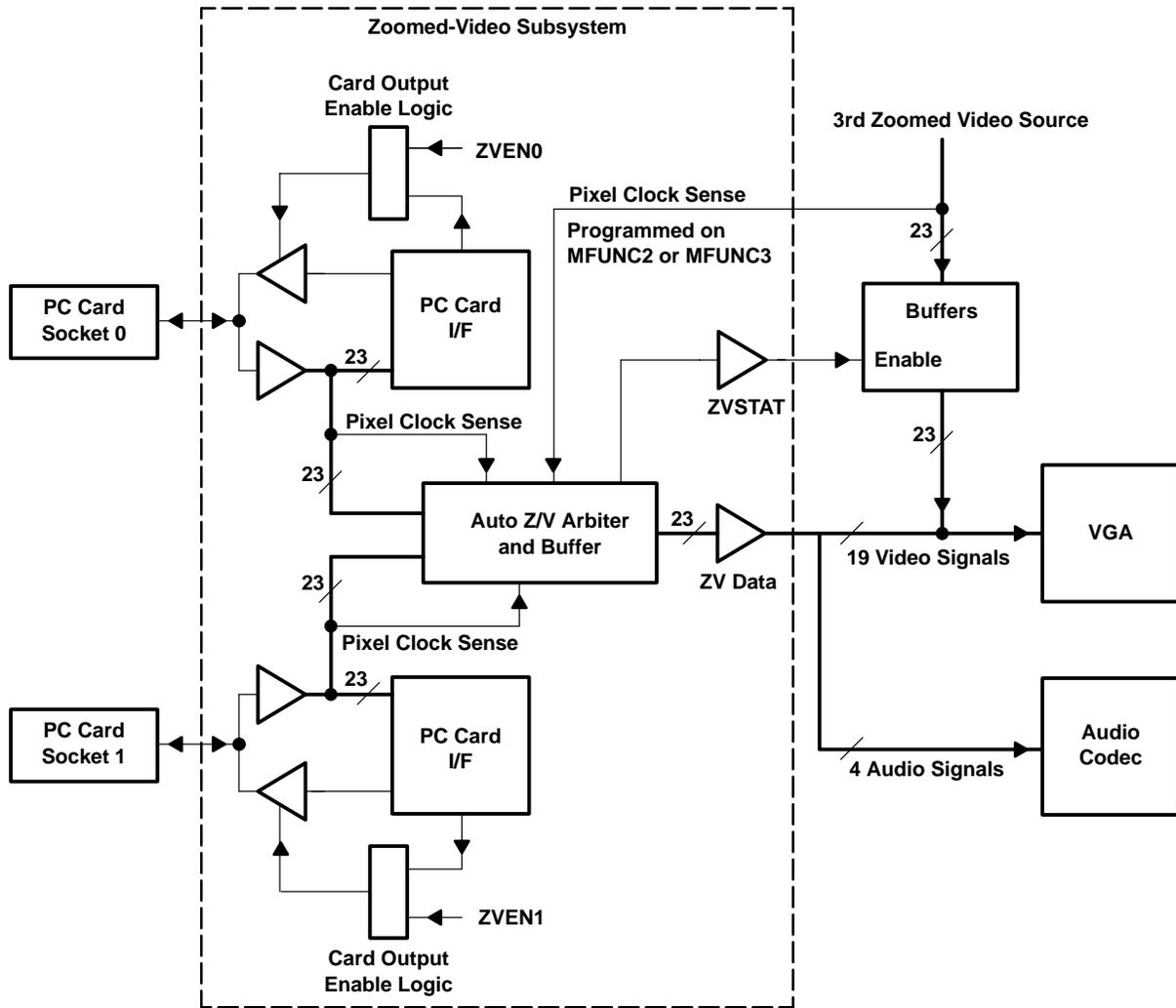


Figure 3–11. Zoomed Video With Autodetect Enabled

The PCI1451A device defaults with ZV autodetect disabled so that it will function exactly like the PCI1250A and PCI1251B devices. To enable ZV auto-detect and the programmable priority scheme, the following bits must be set:

- Multimedia control register (PCI offset 84h) bit 5: Writing a 1b enables ZV autodetect.
- Multimedia control register (PCI offset 84h) bits 4–2: Set the programmable priority scheme:

000 = Slot A, Slot B, External Source

001 = Slot A, External Source, Slot B

010 = Slot B, Slot A, External Source

011 = Slot B, External Source, Slot A

100 = External Source, Slot A, Slot B

101 = External Source, Slot B, Slot A

110 = External Source, Slot B, Slot A

111 = Reserved

If it is desired to switch a third ZV source, the following bits must also be set:

- Multifunction routing status register (PCI offset 8Ch, see Section 4.36), bits 14–12 or 10–8: Write 111b to program MFUNC3 or MFUNC2 as a pixel clock input terminal.
- Multifunction routing status register (PCI offset 8Ch, see Section 4.36), bits 18–16, 6–4, or 2–0: Write 111b to program MFUNC4, MFUNC1, or MFUNC0 terminal.

3.4.5 Ultrazoomed Video

Ultrazoomed video is an enhancement to the PCI1451A DMA engine and is intended to improve the 16-bit bandwidth for MPEG I and MPEG II decoder PC Cards. This enhancement allows the PCI1451A device to fetch 32 bits of data from memory, versus the PCI11XX or PCI12XX 16-bit fetch capability. This enhancement allows a higher sustained throughput to the 16-bit PC Card, because the PCI1451A device prefetches an extra 16 bits (32 bits total) during each PCI read transaction. If the PCI bus becomes busy, the PCI1451A device has an extra 16 bits of data to perform back-to-back 16-bit transactions to the PC Card before having to fetch more data. This feature is built into the DMA engine and software is not required to enable this enhancement.

NOTE: The PCI11XX and PCI12XX series CardBus controllers have enough 16-bit bandwidth to support MPEG II PC Card decoders. But, it was decided to improve the bandwidth even more in the PCI14XX series CardBus controllers.

3.4.6 $\overline{D3_STAT}$ Terminal

Additional functionality added for the PCI1451A device versus the PCI1250A or PCI1251 series is the $\overline{D3_STAT}$ (D3 status) terminal. This terminal is asserted under the following two conditions (both conditions must be true before $\overline{D3_STAT}$ is asserted):

- Function 0 and Function 1 are placed in D3
- \overline{PME} is enabled on either function

The intent of including this feature in the PCI1451A device is to use this pin to switch an external V_{CC}/V_{AUX} switch. This feature can be programmed on MFUNC7, MFUNC6, MFUNC2, or MFUNC1 by writing 100b to the appropriate multifunction routing status register bits (PCI offset 8Ch, see Section 4.36).

3.4.7 Internal Ring Oscillator

The internal ring oscillator provides an internal clock source for the PCI1451A device so that neither the PCI clock nor an external clock is required for the PCI1451A device to power down a socket or interrogate a PC Card. This internal oscillator operates nominally at 16 kHz and can be enabled by setting bit 27 (P2CCLK) of the system control register (PCI offset 80h, see Section 4.29) to 1. This function is disabled by default.

3.4.8 Integrated Pullup Resistors

The *PC Card Standard* requires pullup resistors on various terminals to support both CardBus and 16-bit card configurations. Unlike the PCI1450 or PCI4450 device, which required external pullup resistors, the PCI1451A device has integrated all of these pullup resistors, except for the WP(IOIS16)/CLKRUN pullup resistor.

SIGNAL NAME	GJG TERMINAL NUMBER	
	SOCKET A	SOCKET B
ADDR14/ $\overline{\text{CPERR}}$	D1	C18
READY/ $\overline{\text{CINT}}$	K2	E11
ADDR15/ $\overline{\text{CIRDY}}$	F4	B16
$\overline{\text{CD1}}$ / $\overline{\text{CCD1}}$	F8	J19
$\overline{\text{VS1}}$ / $\overline{\text{CVS1}}$	K1	B11
ADDR19/ $\overline{\text{CBLOCK}}$	C2	D16
ADDR20/ $\overline{\text{CSTOP}}$	D2	B19
ADDR21/ $\overline{\text{CDEVSEL}}$	E5	A18
ADDR22/ $\overline{\text{CTRDY}}$	F5	B17
$\overline{\text{VS2}}$ / $\overline{\text{CVS2}}$	H6	A14
RESET/ $\overline{\text{CRST}}$	H2	F13
$\overline{\text{WAIT}}$ / $\overline{\text{CSERR}}$	K4	F11
$\overline{\text{INPACK}}$ / $\overline{\text{CREQ}}$	J4	A13
BVD2(SPKR)/CAUDIO	L6	F10
BVD1($\overline{\text{STSCHG}}$)/ $\overline{\text{CSTSCHG}}$	L1	A10
$\overline{\text{CD2}}$ / $\overline{\text{CCD2}}$	L4	D10
WP(IOIS16)/ $\overline{\text{CLKRUN}}$	L2†	B10†

† This terminal requires pullup, but the PCI1451A device lacks an integrated pullup resistor.

3.4.9 SPKROUT Usage

The SPKROUT signal carries the digital audio signal from the PC Card to the system. When a 16-bit PC Card is configured for I/O mode, the BVD2 terminal becomes SPKR. This terminal also is used in CardBus applications, and is referred to as CAUDIO. SPKR passes a TTL-level digital audio signal to the PCI1451A device. The CardBus CAUDIO signal also can pass a single-amplitude binary waveform. The binary audio signals from the two PC Card sockets are XORed in the PCI1451A device to produce SPKROUT. Figure 3–12 illustrates the SPKROUT connection.

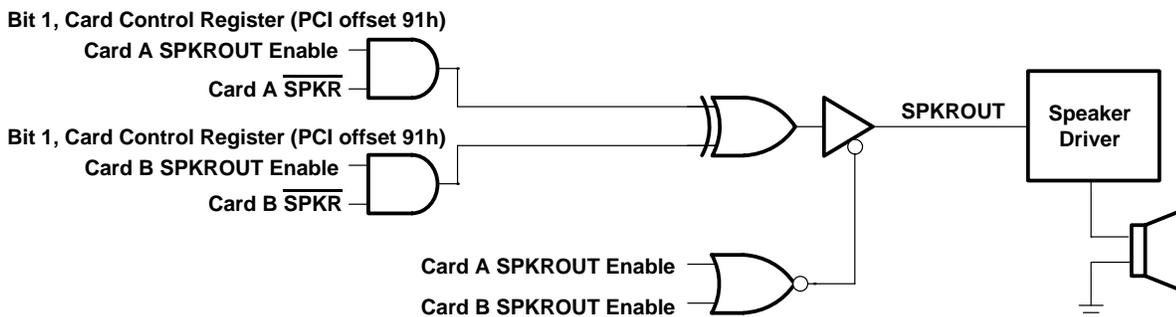


Figure 3–12. SPKROUT Connection to Speaker Driver

The SPKROUT signal is typically driven only by PC modem cards. To verify the SPKROUT on the PCI1451A device, a sample circuit was constructed, and this simplified schematic is shown in Figure 3–13. The PCI1130 and PCI1131 devices required a pullup resistor on the $\overline{\text{SUSPEND}}$ /SPKROUT terminal. Since the PCI1451A device does not multiplex any other function on SPKROUT, this terminal does not require a pullup resistor.

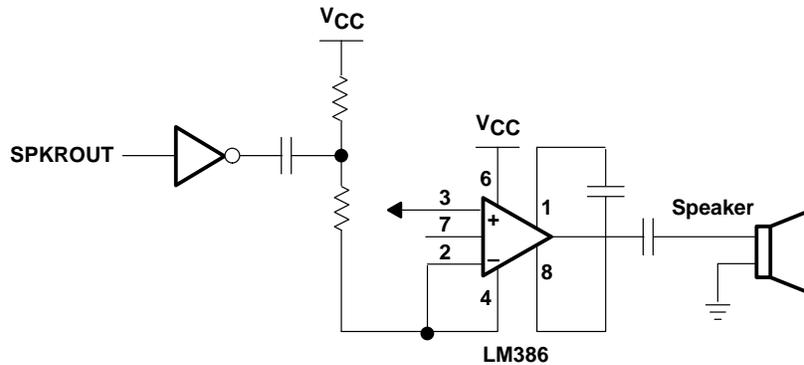


Figure 3–13. Simplified Test Schematic

3.4.10 LED Socket Activity Indicators

The socket activity LEDs indicate when an access is occurring to a PC Card. The LED signals are programmable via the MFUNC register. When configured for LED outputs, these terminals output an active high signal to indicate socket activity. LEDA1 indicates socket 0 (card A) activity, and LEDA2 indicates socket 1 (card B) activity.

The LED signal is active-high and is driven in pulses of 64-ms duration. When the LED is not being driven high, it is driven to a low state. Either of the two circuits shown in Figure 3–14 can be implemented to provide the LED signaling, and it is left for the board designer to implement the circuit that best fits the application.

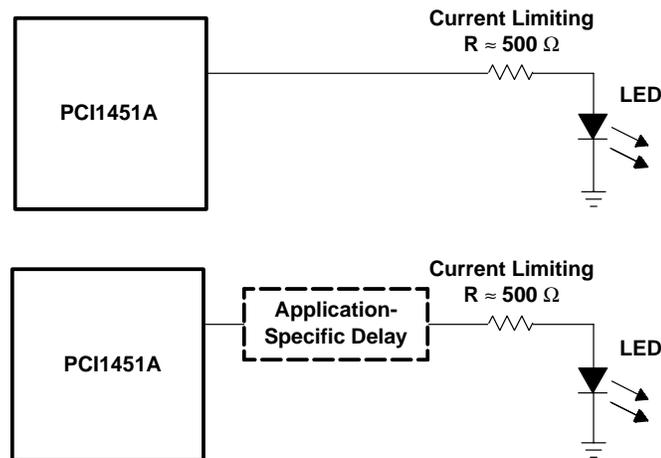


Figure 3–14. Two Sample LED Circuits

As indicated, the LED signals are driven for 64 ms, and this is accomplished by a counter circuit. To avoid the possibility of the LEDs appearing to be stuck when the PCI clock is stopped, the LED signaling is cut off either when the SUSPEND signal is asserted or when the PCI clock is to be stopped per the CLKRUN protocol.

If any additional socket activity occurs during this counter cycle, the counter is reset and the LED signal remains driven. If socket activity is frequent (at least once every 64 ms), the LED signals remain driven.

3.4.11 PC Card 16 DMA Support

The PCI1451A device supports both PC/PCI (centralized) DMA and a distributed DMA slave engine for 16-bit PC Card DMA support. The distributed DMA (DDMA) slave register set provides the programmability necessary for the slave DDMA engine. Table 3–3 provides the DDMA register configuration.

Table 3–3. Distributed DMA Registers

TYPE	REGISTER NAME				DMA BASE ADDRESS OFFSET
R	Reserved	Page	Current address		00h
W			Base address		
R	Reserved	Reserved	Current count		04h
W			Base count		
R	N/A	Reserved	N/A	Status	08h
W	Mode		Request	Command	
R	Multichannel	Reserved	N/A		0Ch
W	Mask		Master clear		

3.4.12 CardBus Socket Registers

The PCI1451A device contains all registers for compatibility with the *PC Card Standard*. These registers exist as the CardBus socket registers and are listed in Table 3–4.

Table 3–4. CardBus Socket Registers

REGISTER NAME	OFFSET
Socket event	00h
Socket mask	04h
Socket present state	08h
Socket force event	0Ch
Socket control	10h
Reserved	14h
Reserved	18h
Reserved	1Ch
Socket power management	20h

3.5 Programmable Interrupt Subsystem

Interrupts provide a way for I/O devices to let the microprocessor know that they require servicing. The dynamic nature of PC Cards and the abundance of PC Card I/O applications require substantial interrupt support from the PCI1451A device. The PCI1451A device provides several interrupt signaling schemes to accommodate the needs of a variety of platforms. The different mechanisms for dealing with interrupts in this device are based upon various specifications and industry standards. The ExCA register set provides interrupt control for some 16-bit PC Card functions, and the CardBus socket register set provides interrupt control for the CardBus PC Card functions. The PCI1451A device is, therefore, backward compatible with existing interrupt control register definitions, and new registers have been defined where required.

The PCI1451A device detects PC Card interrupts and events at the PC Card interface and notifies the host controller, using one of several interrupt signaling protocols. To simplify the discussion of interrupts in the PCI1451A device, PC Card interrupts are classified either as card status change (CSC) or as functional interrupts.

The method by which any type of PCI1451A interrupt is communicated to the host interrupt controller varies from system to system. The PCI1451A device offers system designers the choice of using parallel PCI interrupt signaling, parallel ISA-type IRQ interrupt signaling, or the IRQSER serialized ISA and/or PCI interrupt protocol. Traditional ISA IRQ signaling is provided through eight IRQMUX terminals. It is possible to use the parallel PCI interrupts in combination with either parallel IRQs or serialized IRQs, as detailed in the sections that follow.

3.5.1 PC Card Functional and Card Status Change Interrupts

PC Card functional interrupts are defined as requests from a PC Card application for interrupt service. They are indicated by asserting specially defined signals on the PC Card interface. Functional interrupts are generated by 16-bit I/O PC Cards and by CardBus PC Cards.

Card status change (CSC)-type interrupts are defined as events at the PC Card interface that are detected by the PCI1451A device, and may warrant notification of host card and socket services software for service. CSC events include both card insertion and removal from PC Card sockets, as well as transitions of certain PC Card signals.

Table 3–5 summarizes the sources of PC Card interrupts and the type of card associated with them. CSC and functional interrupt sources are dependent upon the type of card inserted in the PC Card socket. The three types of cards that can be inserted into any PC Card socket are:

- 16-bit memory card
- 16-bit I/O card
- CardBus cards

Functional interrupt events are valid only for 16-bit I/O and CardBus cards; that is, the functional interrupts are not valid for 16-bit memory cards. Furthermore, card insertion- and removal-type CSC interrupts are independent of the card type.

Table 3–5. PC Card Interrupt Events and Description

Card Type	Event	Type	Signal	Description
16-bit Memory	Battery conditions (BVD1, BVD2)	CSC	BVD1 ($\overline{\text{STSCHG}}$) // CSTSCHG	A transition on the BVD1 signal indicates a change in the PC Card battery conditions.
		CSC	BVD2 ($\overline{\text{SPKR}}$) // CAUDIO	A transition on the BVD2 signal indicates a change in the PC Card battery conditions.
	Wait states (READY)	CSC	READY ($\overline{\text{IREQ}}$) // $\overline{\text{CINT}}$	A transition on the READY signal indicates a change in the ability of the memory PC Card to accept or provide data.
16-bit I/O	Change in card status (STSCHG)	CSC	BVD1 ($\overline{\text{STSCHG}}$) // CSTSCHG	The assertion of the $\overline{\text{STSCHG}}$ signal indicates a status change on the PC Card.
	Interrupt request (IREQ)	Functional	READY ($\overline{\text{IREQ}}$) // $\overline{\text{CINT}}$	The assertion of the $\overline{\text{IREQ}}$ signal indicates an interrupt request from the PC Card.
CardBus	Change in card status (CSTSCHG)	CSC	BVD1 ($\overline{\text{STSCHG}}$) // CSTSCHG	The assertion of the CSTSCHG signal indicates a status change on the PC Card.
	Interrupt request ($\overline{\text{CINT}}$)	Functional	READY ($\overline{\text{IREQ}}$) // $\overline{\text{CINT}}$	The assertion of the $\overline{\text{CINT}}$ signal indicates an interrupt request from the PC Card.
	Power cycle complete	CSC	N/A	An interrupt is generated when a PC Card power-up cycle has completed.
All PC Cards	Card insertion or removal	CSC	CD1 // CCD1, CD2 // CCD2	A transition on either the $\overline{\text{CD1}}//\overline{\text{CCD1}}$ signal or the $\overline{\text{CD2}}//\overline{\text{CCD2}}$ signal indicates an insertion or removal of a 16-bit // CardBus PC Card.
	Power cycle complete	CSC	N/A	An interrupt is generated when a PC Card power-up cycle has completed.

The signal naming convention for PC Card signals describes the function for 16-bit memory, I/O, and CardBus cards. For example, the $\text{READY}(\overline{\text{IREQ}})//\overline{\text{CINT}}$ signal includes the READY signal for 16-bit memory cards, the $\overline{\text{IREQ}}$ signal for 16-bit I/O cards, and the $\overline{\text{CINT}}$ signal for CardBus cards. The 16-bit memory card signal name is first, with the I/O card signal name second enclosed in parentheses. The CardBus signal name follows after a double slash (//).

The *PC Card Standard* describes the power-up sequence that must be followed by the PCI1451A device when an insertion event occurs and the host requests that the socket V_{CC} and V_{PP} be powered. Upon completion of this power-up sequence, the PCI1451A interrupt scheme may be used to notify the host system (see Table 3–5), denoted by the power cycle complete event. This interrupt source is considered a PCI1451A internal event because it depends on the completion of applying power to the socket rather than on a signal change at the PC Card interface.

3.5.2 Interrupt Masks and Flags

Host software may individually mask (disable) most of the potential interrupt sources listed in Table 3–6 by setting the appropriate bits in the PCI1451A device. By individually masking the interrupt sources listed in these tables, software can control which events cause a PCI1451A interrupt. Host software has some control over which system interrupt the PCI1451A device asserts by programming the appropriate routing registers. The PCI1451A device allows host software to route PC Card CSC and PC Card functional interrupts to separate system interrupts. Interrupt routing is somewhat specific to the interrupt signaling method used. This is discussed in more detail in the following sections.

When an interrupt is signaled by the PCI1451A device, the interrupt service routine must determine which of the events listed in Table 3–6 caused the interrupt. Internal registers in the PCI1451A device provide flags that report the source of an interrupt. By reading these status bits, the interrupt service routine can determine the action to be taken.

Table 3–6 details the registers and bits associated with masking and reporting potential interrupts. All interrupts may be masked, except the functional PC Card interrupts, and an interrupt status flag is available for all types of interrupts.

Table 3–6. PCI1451A Interrupt Mask and Flag Registers

Card Type	Event	Mask	Flag
16-bit Memory	Battery conditions (BVD1, BVD2)	ExCA offset 05h/45h/805h bits 1 and 0	ExCA offset 04h/44h/804h bits 1 and 0
	Wait states (READY)	ExCA offset 05h/45h/805h bit 2	ExCA offset 04h/44h/804h bit 2
16-bit I/O	Change in card status (STSCHG)	ExCA offset 05h/45h/805h bit 0	ExCA offset 04h/44h/804h bit 0
	Interrupt request (IREQ)	Always enabled	PCI configuration offset 91h bit 0
All 16-bit PC Cards	Power cycle complete	ExCA offset 05h/45h/805h bit 3	ExCA offset 04h/44h/804h bit 3
CardBus	Change in card status (CSTSCHG)	Socket mask bit 0	Socket event bit 0
	Interrupt request (CINT)	Always enabled	PCI configuration offset 91h bit 0
	Power cycle complete	Socket mask bit 3	Socket event bit 3
	Card insertion or removal	Socket mask bits 2 and 1	Socket event bits 2 and 1

There is no mask bit to stop the PCI1451A device from passing PC Card functional interrupts through to the appropriate interrupt scheme. Functional interrupts should not be fired until the PC Card is initialized and powered.

Table 3–6 lists the various methods of clearing the interrupt flag bits. The flag bits in the ExCA registers (16-bit PC Card-related interrupt flags) can be cleared using two different methods. One method is an explicit write of 1 to the flag bit to clear, and the other is a reading of the flag bit register. The selection of flag bit clearing is made by bit 2 (IFCMODE) in the ExCA global control register (ExCA offset 1Eh/5Eh, see Section 5.22) and defaults to the *flag cleared on read* method.

The CardBus-related interrupt flags can only be cleared by an explicit write of 1 to the interrupt flag in the socket force event register (CardBus offset 0Ch, see Section 6.4). Although some of the functionality is shared between the CardBus registers and the ExCA registers, software should not program the chip through both register sets when a CardBus card is functioning.

3.5.3 Using Parallel PCI Interrupts

Parallel PCI interrupts are available when in pure parallel PCI interrupt mode and are routed on MFUNC0–MFUNC2. The PCI interrupt signaling is dependent upon the interrupt mode and is summarized in Table 3–7. The interrupt mode is selected in the device control register (PCI offset 92h, see Section 4.39).

Table 3–7. Interrupt Pin Register Cross Reference

Interrupt Signaling Mode	INTPIN Function 0	INTPIN Function 1
Parallel PCI interrupts only	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)
Reserved	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)
IRQ serialized (IRQSER) & parallel PCI interrupts	01h ($\overline{\text{INTA}}$)	01h ($\overline{\text{INTA}}$)
IRQ & PCI serialized (IRQSER) interrupts (default)	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)

3.6 Power-Management Overview

In addition to the low-power CMOS technology process used for the PCI1451A device, various features are designed into the device to allow implementation of popular power saving techniques. These features and techniques are discussed in this section.

3.6.1 Clock-Run Protocol

$\overline{\text{CLKRUN}}$ is the primary method of power management on the PCI bus side of the PCI1451A device. Because some chipsets do not implement $\overline{\text{CLKRUN}}$, this is not always available to the system designer, and alternate power-saving features are provided.

If $\overline{\text{CLKRUN}}$ is not implemented, the $\overline{\text{CLKRUN}}$ terminal should be tied low. $\overline{\text{CLKRUN}}$ is enabled by default via bit 1 (KEEPCLK) in the system control register (PCI offset 80h, see Section 4.29).

3.6.2 CardBus PC Card Power Management

The PCI1451A device implements its own card power management engine that can turn off CCLK to a socket when there is no activity to the CardBus PC Card. CCLK can also be configured as divide-by-16 instead of stopped. The $\overline{\text{CLKRUN}}$ protocol is followed on the CardBus interface to control this clock management.

3.6.3 PCI Bus Power Management

The *PCI Bus Power Management Interface Specification* (PCIPM) establishes the infrastructure required to let the operating system control the power of PCI functions. This is done by defining a standard PCI interface and operations to manage the power of PCI functions on the bus. The PCI bus and the PCI functions can be assigned one of four software-visible power-management states that result in varying levels of power savings.

The four power management states of PCI functions are:

- D0 - Fully-on state
- D1 and D2 - Intermediate states
- D3 - Off state

Similarly, bus power states of the PCI bus are B0–B3. The bus power states B0–B3 are derived from the device power state of the upstream bridge device.

For the operating system (OS) to manage the device power states on the PCI bus, the PCI function supports four power management operations. The four operations are:

- Capabilities reporting
- Power status reporting
- Setting the power state
- System wake-up

The OS identifies the capabilities of the PCI function by traversing the new capabilities list. The presence of new capabilities is indicated by a 1 in bit 4 (CAPLIST) of the status register (PCI offset 06h, see Section 4.5). When software determines that the device has a capabilities list by seeing that bit 4 of the status register is set, it reads the

capability pointer register (PCI offset 14h, see Section 4.13). This value in the register points to the location in PCI configuration space of the capabilities-linked list.

The first byte of each capability register block is required to be a unique ID of that capability. PCI power management has been assigned an ID of 01h. The next byte is a pointer to the next pointer item in the list of capabilities. If there are no more items in the list, the next item pointer should be set to 0. The registers following the next item pointer are specific to the function's capability. The PCI power management capability implements the register depicted in Table 3–8.

Table 3–8. Power Management Register Block

REGISTER NAME			OFFSET
Power management capabilities	Next-item pointer	Capability ID	A0h
PM data	PMCSR bridge support extensions	Power management control/status	A4h

The power management capabilities register (PCI offset A2h, see Section 4.45) provides information on the capabilities of the function related to power management. The power management control/status register (PCI offset A4h, see Section 4.46) enables control of power management states and enables/monitors power management events. The data register is an optional register that provides a mechanism for state-dependent power measurements such as power consumed or heat dissipation.

3.6.4 CardBus Device Class Power Management

The *PCI Bus Power Management Interface Specification for PCI-to-CardBus Bridges* was approved by PCMCIA in December of 1997. This specification follows the device and bus state definitions provided in the *PCI Bus Power Management Interface Specification* published by the PCI Special Interest Group (SIG). The main issue addressed in the *PCI Bus Power Management Interface Specification for PCI to CardBus Bridges* is wake-up from D3_{hot} or D3_{cold} without losing wake-up context (also called $\overline{\text{PME}}$ context).

The specific issues addressed by the *PCI Bus Power Management Interface Specification for PCI to CardBus Bridges* for D3 wake-up are as follows:

- Preservation of device context: The specification states that $\overline{\text{PRST}}$ must be asserted when transitioning from D3_{cold} to D0. Some method to preserve wake-up context must be implemented so that $\overline{\text{PRST}}$ does not clear the $\overline{\text{PME}}$ context registers.
- Power source in D3_{cold} if wake-up support is required from this state.

The Texas Instruments PCI1451A device addresses these D3 wake-up issues in the following manner:

- Preservation of device context: When $\overline{\text{PRST}}$ is asserted, bits required to preserve $\overline{\text{PME}}$ context are not cleared. To clear all bits in the PCI1451A device, another reset terminal is defined: $\overline{\text{GRST}}$ (global reset). $\overline{\text{GRST}}$ normally is only asserted during the initial power-on sequence. After the initial boot, $\overline{\text{PRST}}$ should be asserted so that $\overline{\text{PME}}$ context is retained for D3-to-D0 transitions. Bits cleared by $\overline{\text{GRST}}$, but not cleared by $\overline{\text{PRST}}$ (if the $\overline{\text{PME}}$ enable bit is set), are referred to as $\overline{\text{PME}}$ context bits. Please refer to the master list of $\overline{\text{PME}}$ context bits in Section 3.6.5.
- Power source in D3_{cold} if wake-up support is required from this state. Since V_{CC} is removed in D3_{cold}, an auxiliary power source must be switched to the PCI1451A V_{CC} terminals. This switch should be a *make before break* type of switch, so that V_{CC} to the PCI1451A device is not interrupted.

3.6.5 Master List Of $\overline{\text{PME}}$ Context Bits and Global Reset-Only Bits

$\overline{\text{PME}}$ context bit means that the bit is cleared only by the assertion of $\overline{\text{GRST}}$ when the $\overline{\text{PME}}$ enable bit is set (PCI offset A4h, bit 8). If $\overline{\text{PME}}$ is not enabled, these bits are cleared when either $\overline{\text{PRST}}$ or $\overline{\text{GRST}}$ is asserted.

Global reset-only bits, as the name implies, are only cleared by $\overline{\text{GRST}}$. These bits are never cleared by $\overline{\text{PRST}}$ regardless of the setting of the $\overline{\text{PME}}$ enable bit. (PCI offset A4h, bit 8). The $\overline{\text{GRST}}$ signal is gated only by the $\overline{\text{SUSPEND}}$ signal. This means that assertion of $\overline{\text{SUSPEND}}$ blocks the $\overline{\text{GRST}}$ signal internally, thus preserving all register contents.

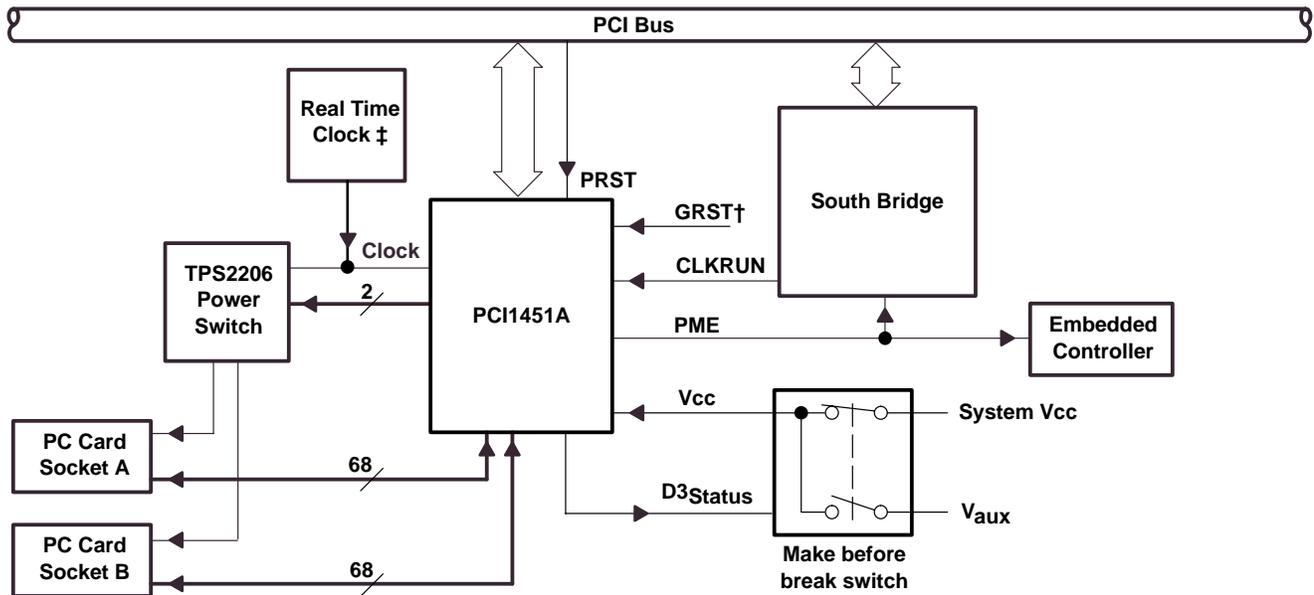
Global reset-only bits:

- Subsystem vendor ID (PCI offset 40h, see Section 4.26): bits 15–0
- Subsystem ID (PCI offset 42h, see Section 4.27): bits 15–0
- PC Card 16-bit I/F legacy mode base address register (PCI offset 44h, see Section 4.28): bits 31–1
- System control register (PCI offset 80h, see Section 4.29): bits 31–29, 27–24, 22–14, 6–3, 1, 0
- Multimedia control register (PCI offset 84h, see Section 4.30): bits 7–0
- General status register (PCI offset 85h, see Section 4.31): bits 2–0
- General-purpose event status register (PCI offset 88h, see Section 4.32): bits 7, 6, 3–0
- General-purpose event enable register (PCI offset 89h, see Section 4.33): bits 7, 6, 3–0
- General-purpose input register (PCI offset 8Ah, see Section 4.34): bits 3–0
- General-purpose output register (PCI offset 8Bh, see Section 4.35): bits 3–0
- Multifunction routing register (PCI offset 8Ch, see Section 4.36): bits 31–0
- Retry status register (PCI offset 90h, see Section 4.37): bits 7–1
- Card control register (PCI offset 91h, see Section 4.38): bits 7, 6, 2, 1, 0
- Device control register (PCI offset 92h, see Section 4.39): bits 7–0
- Diagnostic register (PCI offset 93h, see Section 4.40): bits 7–0
- Socket DMA register 0 (PCI offset 94h, see Section 4.41): bits 1–0
- Socket DMA register 1 (PCI offset 98h, see Section 4.42): bits 15–0
- General-purpose event control/status register (PCI offset A8h, see Section 4.48): bits 10, 9, 8, 2, 1, 0

PME context bits

- Bridge control register (PCI offset 3Eh, see Section 4.25): bit 6
- Power management capabilities register (PCI offset A2h, see Section 4.45): bit 15
- Power management control/status register (PCI offset A4h, see Section 4.46): bits 15, 8
- ExCA power control register (ExCA offset 02h/42h, see Section 5.3): bits 7, 4, 3, 1, 0
- ExCA interrupt and general control register (ExCA offset 03h/43h, see Section 5.4): bit 6, 5
- ExCA card status change register (ExCA offset 04h/44h, see Section 5.5): bits 3–0
- ExCA card status change interrupt configuration register (ExCA offset 05h/45h, see Section 5.6): bits 3–0
- CardBus socket event register (CardBus offset 00h, see Section 6.1): bits 3–0
- CardBus socket mask register (CardBus offset 04h, see Section 6.2): bits 3–0
- CardBus socket control register (CardBus offset 10h, see Section 6.5): bits 6–4, 2–0

3.6.6 System Diagram Implementing CardBus Device Class Power Management



† The system connection to $\overline{\text{GRST}}$ is implementation specific. $\overline{\text{GRST}}$ should be applied whenever V_{CC} is applied to the PCI1451A device. $\overline{\text{PRST}}$ should be applied for subsequent warm resets.

‡ Not required if internal oscillator is used.

Figure 3–15. System Diagram Implementing CardBus Device Class Power Management

3.6.7 Suspend Mode

The $\overline{\text{SUSPEND}}$ signal, provided for backward compatibility, gates the $\overline{\text{PRST}}$ (PCI reset) signal and the $\overline{\text{GRST}}$ (global reset) signal from the PCI1451A device. Besides gating $\overline{\text{PRST}}$ and $\overline{\text{GRST}}$, $\overline{\text{SUSPEND}}$ also gates PCLK inside the PCI1451A device to minimize power consumption.

Gating PCLK does not create any issues with respect to the power-switch interface in the PCI1451A device. This is because the PCI1451A device does not depend on the PCI clock for clocking the power-switch interface. There are two methods to clock the power-switch interface in the PCI1451A device:

- Use an external clock to the PCI1451A CLOCK terminal
- Use the internal oscillator

It also should be noted that asynchronous signals, such as card status change interrupts and $\overline{\text{RI_OUT}}$, can be passed to the host system without a PCI clock. However, if card status change interrupts are routed over the serial interrupt stream, the PCI clock will have to be restarted to pass the interrupt, because neither the internal oscillator nor an external clock is routed to the serial interrupt state machine. Figure 3–16 shows the suspend function.

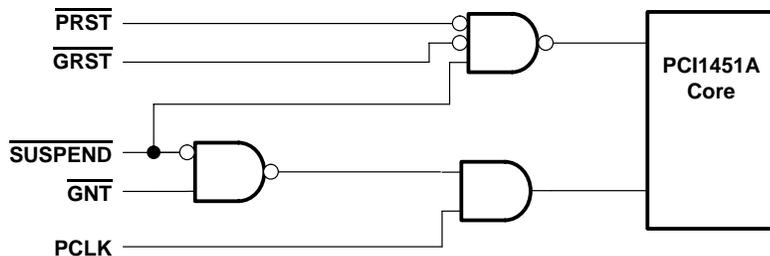


Figure 3–16. $\overline{\text{SUSPEND}}$ Functional Illustration

3.6.8 Requirements for Suspend Mode

A requirement for implementing suspend mode is that the PCI bus must not be parked on the PCI1451A device when $\overline{\text{SUSPEND}}$ is asserted. The PCI1451A device responds to $\overline{\text{SUSPEND}}$ being asserted by placing the $\overline{\text{REQ}}$ terminal in a high-impedance state. The PCI1451A device also gates the internal clock and reset.

The GPIOs, MFUNC signals, and $\overline{\text{RI_OUT}}$ signals are all active during $\overline{\text{SUSPEND}}$, unless they are disabled in the appropriate PCI1451A registers.

3.6.9 Ring Indicate

The $\overline{\text{RI_OUT}}$ output is an important feature used in legacy power management. It is used so that a system can go into a suspended mode and wake up on modem rings and other card events. The $\overline{\text{RI_OUT}}$ signal on the PCI1451A device may be asserted under any of the following conditions:

- A 16-bit PC Card modem in a powered socket asserts $\overline{\text{RI}}$ to indicate an incoming call to the system.
- A powered down CardBus card asserts CSTSCHG (CBWAKE) requesting system and interface wake-up.
- A card status change (CSC) event, such as insertion/removal of cards, battery voltage levels, occurs.

A CSTSCHG signal from a powered CardBus card is indicated as a CSC event, not as a CBWAKE event. These two $\overline{\text{RI_OUT}}$ events are enabled separately. Figure 3–17 details various enable bits for the PCI1451A $\overline{\text{RI_OUT}}$ function; however, it does not illustrate the masking of CSC events. See Section 3.5.2, *Interrupt Masks and Flags*, for a detailed description of CSC interrupt masks and flags.

$\overline{\text{RI_OUT}}$ is multiplexed on the same pin with $\overline{\text{PME}}$. The default is for $\overline{\text{RI_OUT}}$ to be signaled on this pin. In PCI power managed systems, the $\overline{\text{PME}}$ signal should be enabled by setting bit 0 ($\overline{\text{RI_OUT/PME}}$) in the system control register (PCI offset 80h, see Section 4.29) and clearing bit 7 (RIENB) in the card control register (PCI offset 91h, see Section 4.38).

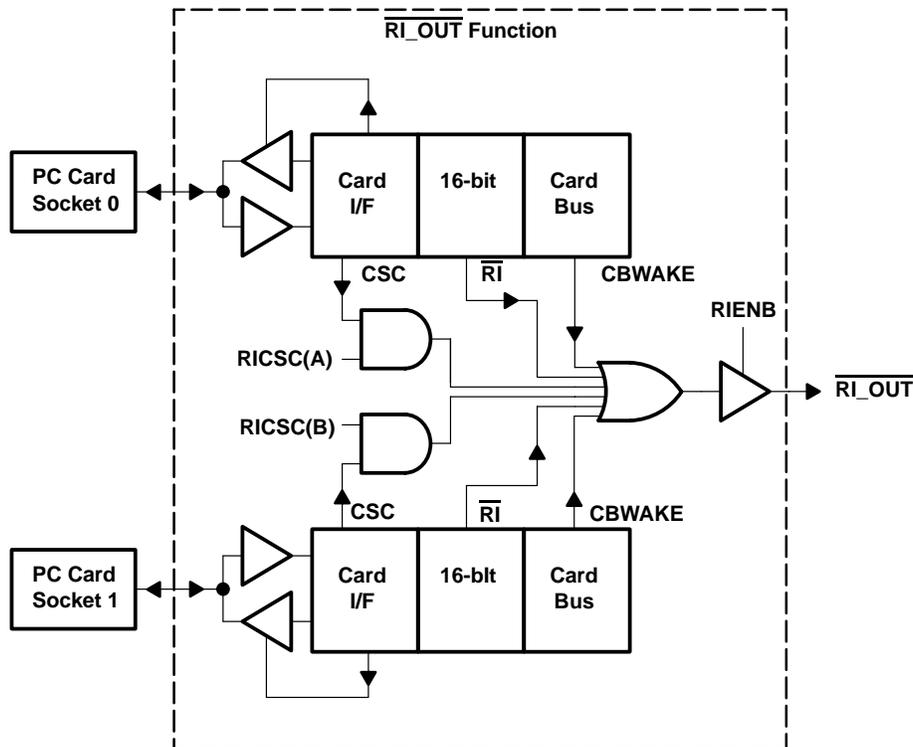


Figure 3–17. $\overline{\text{RI_OUT}}$ Functional Illustration

Routing of CSC events to the $\overline{\text{RI_OUT}}$ signal, enabled on a per-socket basis, is programmed by setting bit 7 ((RIENB) of the the card control register (PCI offset 91h, see Section 4.38) and bit 7 (RINGEN) of the ExCA interrupt and general control register (ExCA offset 803h, see Section 5.4). This bit is socket-dependent (not shared), as shown in Figure 3–17.

The $\overline{\text{RI}}$ signal from the 16-bit PC Card interface is masked by bit 7 (RINGEN) in the ExCA interrupt and general control register (ExCA offset 03h/43h, see Section 5.4). This is programmed on a per-socket basis, and is only applicable when a 16-bit card is powered in the socket.

The CBWAKE signaling to $\overline{\text{RI_OUT}}$ is enabled through the same mask as the CSC event for CSTSCHG. The mask bit (bit 0, CSTSMASK) is programmed through the socket mask register (CardBus offset 04h, see Section 6.2) in the CardBus socket registers.

4 PC Card Controller Programming Model

This chapter describes the PCI1451A PCI configuration registers that make up the 256-byte PCI configuration header for each PCI1451A function. As noted, some bits are global in nature and are accessed only through function 0.

4.1 PCI Configuration Registers (Functions 0 and 1)

The PCI1451A device is a multifunction PCI device, and the PC Card controller is integrated as PCI functions 0 and 1. The configuration header is compliant with the *PCI Local Bus Specification* as a CardBus bridge header and is *PC 98/PC 99* compliant as well. Table 4–1 lists the PCI configuration header, which includes both the predefined portion of the configuration space and the user-definable registers.

Table 4–1. Functions 0 and 1 PCI Configuration Register Map

REGISTER NAME			OFFSET
Device ID		Vendor ID	00h
Status		Command	04h
Class code		Revision ID	08h
BIST	Header type	Latency timer	Cache line size
CardBus socket/ExCA base-address			10h
Secondary status		Reserved	Capability pointer
CardBus latency timer	Subordinate bus number	CardBus bus number	PCI bus number
CardBus memory base register 0			1Ch
CardBus memory limit register 0			20h
CardBus memory base register 1			24h
CardBus memory limit register 1			28h
CardBus I/O base register 0			2Ch
CardBus I/O limit register 0			30h
CardBus I/O base register 1			34h
CardBus I/O limit register 1			38h
Bridge control		Interrupt pin	Interrupt line
Subsystem ID		Subsystem vendor ID	
PC Card 16-bit I/F legacy-mode base address			44h
Reserved			48h–7Fh
System control			80h
Reserved	Reserved	General status	Multimedia control
General-purpose output	General-purpose input	General-purpose event enable	General-purpose event status
Multifunction routing status			8Ch
Diagnostic	Device control	Card control	Retry status
Socket DMA register 0			94h
Socket DMA register 1			98h
Reserved			9Ch
Power management capabilities		Next pointer item	Capability ID
Data (Reserved)	Power management control/status bridge support extensions	Power management control/status	
Reserved		GPE control/status	

A bit-description table, typically included when a register contains bits of more than one type or purpose, indicates bit field names, a detailed field description, and field access tags, which appear in the type column of the bit-description table. Table 4–2 describes the field access tags.

Table 4–2. Bit-Field Access Tag Descriptions

ACCESS TAG	NAME	MEANING
R	Read	Field can be read by software.†
W	Write	Field can be written by software to any value.
S	Set	Field can be set by a write of 1. Writes of 0 have no effect.
C	Clear	Field can be cleared by a write of 1. Writes of 0 have no effect.
U	Update	Field can be autonomously updated by the PCI1410A device.

† A bit can display either of two types of behavior when read. After having been read, it can maintain the value it had previously, or the read process can cause it to be reset to 0.

4.2 Vendor ID Register

The vendor ID register contains a value allocated by the PCI Special Interest Group (SIG) that identifies the manufacturer of the PCI device. The vendor ID assigned to Texas Instruments is 104Ch.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Vendor ID															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0

Register: **Vendor ID**
 Type: Read-only
 Offset: 00h (Functions 0, 1)
 Default: 104Ch

4.3 Device ID Register

The device ID register contains a value assigned to the PCI1451A device by Texas Instruments. The device identification for the PCI1451A device is AC52h.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Device ID															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	1	0	1	0	1	1	0	0	0	1	0	1	0	0	1	0

Register: **Device ID**
 Type: Read-only
 Offset: 02h (Functions 0, 1)
 Default: AC52h

4.4 Command Register

The command register provides control over the PCI1451A interface to the PCI bus. All bit functions adhere to the definitions in the *PCI Local Bus Specification*. None of the bit functions in this register are shared between the two PCI1451A PCI functions. Two command registers exist in the PCI1451A device, one for each function. Software manipulates the two PCI1451A functions as separate entities when enabling functionality through the command register. Bit 8 (SERR_EN) and bit 6 (PERR_EN) enable bits in this register are internally wired OR between the two functions, and these control bits appear separate per function to software. See Table 4–3 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Command															
Type	R	R	R	R	R	R	R	R/W	R	R/W	R/W	R	R	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Command**
 Type: Read-only, Read/Write
 Offset: 04h
 Default: 0000h

Table 4–3. PCI Command Register Description

BIT	SIGNAL	TYPE	FUNCTION
15–10	RSVD	R	Reserved. Bits 15–10 return 0s when read.
9	FBB_EN	R	Fast back-to-back enable. The PCI1451A device does not generate fast back-to-back transactions; therefore, bit 9 returns 0 when read.
8	SERR_EN	R/W	System error ($\overline{\text{SERR}}$) enable. Bit 8 controls the enable for the $\overline{\text{SERR}}$ driver on the PCI interface. $\overline{\text{SERR}}$ can be asserted after detecting an address parity error on the PCI bus. Both bits 8 and 6 must be set for the PCI1451A device to report address parity errors. 0 = Disables the $\overline{\text{SERR}}$ output driver (default). 1 = Enables the $\overline{\text{SERR}}$ output driver.
7	STEP_EN	R	Address/data stepping control. The PCI1451A device does not support address/data stepping; therefore, bit 7 is hardwired to 0.
6	PERR_EN	R/W	Parity-error response enable. Bit 6 controls the PCI1451A device response to parity errors through $\overline{\text{PERR}}$. Data parity errors are indicated by asserting $\overline{\text{PERR}}$; whereas address parity errors are indicated by asserting $\overline{\text{SERR}}$. 0 = PCI1451A device ignores detected parity error (default). 1 = PCI1451A device responds to detected parity errors.
5	VGA_EN	R/W	VGA palette snoop. When bit 5 is set to 1, palette snooping is enabled (that is, the PCI1451A device does not respond to palette register writes and snoops the data). When bit 5 is 0, the PCI1451A device treats all palette accesses like all other accesses.
4	MWI_EN	R	Memory write and invalidate enable. Bit 4 controls whether a PCI initiator device can generate memory write and invalidate commands. The PCI1451A controller does not support memory write and invalidate commands. It uses memory write commands instead; therefore, this bit is hardwired to 0.
3	SPECIAL	R	Special cycles. Bit 3 controls whether or not a PCI device ignores PCI special cycles. The PCI1451A device does not respond to special cycle operations; therefore, this bit is hardwired to 0.
2	MAST_EN	R/W	Bus-master control. Bit 2 controls whether or not the PCI1451A device can act as a PCI bus initiator (master). The PCI1451A device can take control of the PCI bus only when this bit is set. 0 = Disables the PCI1451A device's ability to generate PCI bus accesses (default). 1 = Enables the PCI1451A device's ability to generate PCI bus accesses.
1	MEM_EN	R/W	Memory space enable. Bit 1 controls whether or not the PCI1451A device can claim cycles in PCI memory space. 0 = Disables the PCI1451A device's response to memory space accesses (default). 1 = Enables the PCI1451A device's response to memory space accesses.
0	IO_EN	R/W	I/O space control. Bit 0 controls whether or not the PCI1451A device can claim cycles in PCI I/O space. 0 = Disables the PCI1451A device response to I/O space accesses (default). 1 = Enables the PCI1451A device response to I/O space accesses.

4.5 Status Register

The status register provides device information to the host system. Bits in this register can be read normally. A bit in the status register is reset when a 1 is written to that bit location; a 0 written to a bit location has no effect. All bit functions adhere to the definitions in the *PCI Local Bus Specification*. PCI bus status is shown through each function. See Table 4–4 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Status															
Type	RC	RC	RC	RC	RC	R	R	RC	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0

Register: **Status**
 Type: Read-only, Read/Clear
 Offset: 06h (Functions 0, 1)
 Default: 0210h

Table 4–4. Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
15	PAR_ERR	RC	Detected parity error. Bit 15 is set when a parity error (either address or data) is detected. Write a 1 to clear this bit.
14	SYS_ERR	RC	Signaled system error. Bit 14 is set when \overline{SERR} is enabled and the PCI1451A device signals a system error to the host. Write a 1 to clear this bit.
13	MABORT	RC	Received master abort. Bit 13 is set when a cycle initiated by the PCI1451A device on the PCI bus is terminated by a master abort. Write a 1 to clear this bit.
12	TABT_REC	RC	Received target abort. Bit 12 is set when a cycle initiated by the PCI1451A device on the PCI bus is terminated by a target abort. Write a 1 to clear this bit.
11	TABT_SIG	RC	Signaled target abort. Bit 11 is set by the PCI1451A device when it terminates a transaction on the PCI bus with a target abort. Write a 1 to clear this bit.
10–9	PCI_SPEED	R	\overline{DEVSEL} timing. Bits 10 and 9 encode the timing of \overline{DEVSEL} and are hardwired to 01b, indicating that the PCI1451A device asserts PCI_SPEED at a medium speed on nonconfiguration cycle accesses.
8	DATAPAR	RC	Data parity error detected. Write a 1 to clear this bit. 0 = The conditions for setting bit 8 have not been met. 1 = A data parity error occurred, and the following conditions were met: a. \overline{PERR} was asserted by any PCI device, including the PCI1451A device. b. The PCI1451A device was the bus master during the data parity error. c. Bit 6 (PERR_EN) in the command register (PCI offset 04h, see Section 4.4) is set to 1.
7	FBB_CAP	R	Fast back-to-back capable. The PCI1451A device cannot accept fast back-to-back transactions; therefore, bit 7 is hardwired to 0.
6	UDF	R	User-definable feature support. The PCI1451A device does not support the user-definable features; therefore, bit 6 is hardwired to 0.
5	66MHZ	R	66-MHz capable. The PCI1451A device operates at a maximum PCLK frequency of 33 MHz; therefore, bit 5 is hardwired to 0.
4	CAPLIST	R	Capabilities list. Bit 4 returns 1 when read. This bit indicates that capabilities, in addition to standard PCI capabilities, are implemented. The linked list of PCI power management capabilities is implemented in this function.
3–0	RSVD	R	Reserved. Bits 3–0 return 0s when read.

4.6 Revision ID Register

The revision ID register indicates the silicon revision of the PCI1451A device.

Bit	7	6	5	4	3	2	1	0
Name	Revision ID							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	1	0

Register: **Revision ID**
 Type: Read-only
 Offset: 08h (Functions 0, 1)
 Default: 02h

4.7 PCI Class Code Register

The PCI class code register recognizes the PCI1451A functions 0 and 1 as a bridge device (06h) and CardBus bridge device (07h) with a 00h programming interface.

Bit	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Byte	Base Class								Sub Class								Programming Interface								
Name	PCI class code																								
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	

Register: **PCI class code**
 Type: Read-only
 Offset: 09h (Functions 0, 1)
 Default: 06 0700h

4.8 Cache Line Size Register

The cache line size register is programmed by host software to indicate the system cache line size.

Bit	7	6	5	4	3	2	1	0
Name	Cache line size							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **Cache line size**
 Type: Read/Write
 Offset: 0Ch (Functions 0, 1)
 Default: 00h

4.9 Latency Timer Register

The latency timer register specifies the latency timer for the PCI1451A device in units of PCI clock cycles. When the PCI1451A device is a PCI bus initiator and asserts FRAME, the latency timer begins counting from zero. If the latency timer expires before the PCI1451A transaction has terminated, the PCI1451A device terminates the transaction when its GNT is deasserted.

Bit	7	6	5	4	3	2	1	0
Name	Latency timer							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **Latency timer**
 Type: Read/Write
 Offset: 0Dh
 Default: 00h

4.10 Header Type Register

The header type register returns 82h when read, indicating that the PCI1451A functions 0 and 1 configuration spaces adhere to the CardBus bridge PCI header. The CardBus bridge PCI header ranges from PCI register 0 to 7Fh, and 80h–FFh are user-definable extension registers.

Bit	7	6	5	4	3	2	1	0
Name	Header type							
Type	R	R	R	R	R	R	R	R
Default	1	0	0	0	0	0	1	0

Register: **Header type**
 Type: Read-only
 Offset: 0Eh (Functions 0, 1)
 Default: 82h

4.11 BIST Register

Because the PCI1451A device does not support a built-in self-test (BIST), this register returns the value of 00h when read. This register returns 0s for the two PCI1451A functions.

Bit	7	6	5	4	3	2	1	0
Name	BIST							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0

Register: **BIST**
 Type: Read-only
 Offset: 0Fh (Functions 0, 1)
 Default: 00h

4.12 CardBus Socket/ExCA Base-Address Register

The CardBus socket/ExCA base-address register is programmed with a base address referencing the CardBus socket registers and the memory-mapped ExCA register set. Bits 31–12 are read/write and allow the base address to be located anywhere in the 32-bit PCI memory address space on a 4-Kbyte boundary. Bits 11–0 are read-only, returning 0s when read. When software writes all 1s to this register, the value read back will be FFFF F000h, indicating that at least 4K bytes of memory address space are required. The CardBus registers start at offset 000h, and the memory-mapped ExCA registers begin at offset 800h. This register is not shared by functions 0 and 1, mapping each socket control register separately.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	CardBus socket/ExCA base address															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	CardBus socket/ExCA base address															
Type	R/W	R/W	R/W	R/W	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **CardBus socket/ExCA base address**
 Type: Read-only, Read/Write
 Offset: 10h
 Default: 0000 0000h

4.13 Capability Pointer Register

The capability pointer register provides a pointer into the PCI configuration header where the PCI power management register block resides. PCI header doublewords at A0h and A4h provide the power management (PM) registers. Each socket has its own capability pointer register. This register returns A0h when read.

Bit	7	6	5	4	3	2	1	0
Name	Capability pointer							
Type	R	R	R	R	R	R	R	R
Default	1	0	1	0	0	0	0	0

Register: **Capability pointer**
 Type: Read-only
 Offset: 14h
 Default: A0h

4.14 Secondary Status Register

The secondary status register is compatible with the PCI-to-PCI bridge secondary status register and indicates CardBus-related device information to the host system. This register is very similar to the status register (PCI offset 06h, see Section 4.5); status bits are cleared by a writing a 1. This register is not shared by the two socket functions, but is accessed on a per-socket basis. See Table 4–5 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Secondary status															
Type	RC	RC	RC	RC	RC	R	R	RC	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Register: **Secondary status**
 Type: Read-only, Read/Clear
 Offset: 16h
 Default: 0200h

Table 4–5. Secondary Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
15	CBPARITY	RC	Detected parity error. Bit 15 is set when a CardBus parity error (either address or data) is detected. Write a 1 to clear this bit.
14	CBSERR	RC	Signaled system error. Bit 14 is set when \overline{CSERR} is signaled by a CardBus card. The PCI1451A device does not assert CSERR. Write a 1 to clear this bit.
13	CBMABORT	RC	Received master abort. Bit 13 is set when a cycle initiated by the PCI1451A device on the CardBus bus is terminated by a master abort. Write a 1 to clear this bit.
12	REC_CBTA	RC	Received target abort. Bit 12 is set when a cycle initiated by the PCI1451A device on the CardBus bus is terminated by a target abort. Write a 1 to clear this bit.
11	SIG_CBTA	RC	Signaled target abort. Bit 11 is set by the PCI1451A device when it terminates a transaction on the CardBus bus with a target abort. Write a 1 to clear this bit.
10–9	CB_SPEED	R	$\overline{CDEVSEL}$ timing. Bits 10 and 9 encode the timing of $\overline{CDEVSEL}$ and are hardwired to 01b, indicating that the PCI1451A device asserts CB_SPEED at a medium speed.
8	CB_DPAR	RC	CardBus data parity error detected. Write a 1 to clear this bit. 0 = The conditions for setting bit 8 have not been met. 1 = A data parity error occurred and the following conditions were met: a. \overline{CPERR} was asserted on the CardBus interface. b. The PCI1451A device was the bus master during the data parity error. c. Bit 0 (CPERRREN) in the bridge control register (PCI offset 3Eh, see Section 4.25) is set to 1.
7	CBFBB_CAP	R	Fast back-to-back capable. The PCI1451A device cannot accept fast back-to-back transactions; therefore, bit 7 is hardwired to 0.
6	CB_UDF	R	User-definable feature support. The PCI1451A device does not support the user-definable features; therefore, bit 6 is hardwired to 0.
5	CB66MHZ	R	66 MHz capable. The PCI1451A CardBus interface operates at a maximum CCLK frequency of 33 MHz; therefore, bit 5 is hardwired to 0.
4–0	RSVD	R	Reserved. Bits 4–0 return 0s when read.

4.15 PCI Bus Number Register

The PCI bus number register is programmed by the host system to indicate the bus number of the PCI bus to which the PCI1451A device is connected. The PCI1451A device uses this register in conjunction with the CardBus bus number (PCI offset 19h, see Section 4.16) and subordinate bus number (PCI offset 1Ah, see Section 4.17) registers to determine when to forward PCI configuration cycles to its secondary buses.

Bit	7	6	5	4	3	2	1	0
Name	PCI bus number							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **PCI bus number**
 Type: Read/Write
 Offset: 18h (Functions 0, 1)
 Default: 00h

4.16 CardBus Bus Number Register

The CardBus bus number register is programmed by the host system to indicate the bus number of the CardBus bus to which the PCI1451A device is connected. The PCI1451A device uses this register in conjunction with the PCI bus number (PCI offset 18h, see Section 4.15) and subordinate bus number (PCI offset 1Ah, see Section 4.17) registers to determine when to forward PCI configuration cycles to its secondary buses. This register is separate for each PCI1451A controller function.

Bit	7	6	5	4	3	2	1	0
Name	CardBus bus number							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **CardBus bus number**
 Type: Read/Write
 Offset: 19h
 Default: 00h

4.17 Subordinate Bus Number Register

The subordinate bus number register is programmed by the host system to indicate the highest numbered bus below the CardBus bus. The PCI1451A device uses this register in conjunction with the PCI bus number (PCI offset 18h, see Section 4.15) and CardBus bus number (PCI offset 19h, see Section 4.16) registers to determine when to forward PCI configuration cycles to its secondary buses. This register is separate for each CardBus controller function.

Bit	7	6	5	4	3	2	1	0
Name	Subordinate bus number							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **Subordinate bus number**
 Type: Read/Write
 Offset: 1Ah
 Default: 00h

4.18 CardBus Latency Timer Register

The CardBus latency timer register is programmed by the host system to specify the latency timer for the PCI1451A CardBus interface in units of CCLK cycles. When the PCI1451A device is a CardBus initiator and asserts CFRAME, the CardBus latency timer begins counting. If the latency timer expires before the PCI1451A transaction has terminated, the PCI1451A device terminates the transaction at the end of the next data phase. A recommended minimum value for this register of 20h allows most transactions to be completed.

Bit	7	6	5	4	3	2	1	0
Name	CardBus latency timer							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **CardBus latency timer**
 Type: Read/Write
 Offset: 1Bh (Functions 0, 1)
 Default: 00h

4.19 Memory Base Registers 0, 1

The memory base registers indicate the lower address of a PCI memory address range. These registers are used by the PCI1451A device to determine when to forward a memory transaction to the CardBus bus and when to forward a CardBus cycle to the PCI bus. Bits 31–12 of these registers are read/write and allow the memory base to be located anywhere in the 32-bit PCI memory space on 4-Kbyte boundaries. Bits 11–0 are read-only and always return 0s. Write transactions to these bits have no effect. Bits 8 (PREFETCH0) and 9 (PREFETCH1) of the bridge control register (PCI offset 3Eh, see Section 4.25) specify whether memory windows 0 and 1 are prefetchable or nonprefetchable. The memory base register or the memory limit register must be nonzero in order for the PCI1451A device to claim any memory transactions through CardBus memory windows (that is, these windows are not enabled by default to pass the first 4K bytes of memory to CardBus).

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Memory base registers 0, 1															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Memory base registers 0, 1															
Type	R/W	R/W	R/W	R/W	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Memory base registers 0, 1**
 Type: Read-only, Read/Write
 Offset: 1Ch, 24h
 Default: 0000 0000h

4.20 Memory Limit Registers 0, 1

The memory limit registers indicate the upper address of a PCI memory address range. These registers are used by the PCI1451A device to determine when to forward a memory transaction to the CardBus bus and when to forward a CardBus cycle to the PCI bus. Bits 31–12 of these registers are read/write and allow the memory base to be located anywhere in the 32-bit PCI memory space on 4-Kbyte boundaries. Bits 11–0 are read-only and always return 0s. Write transactions to these bits have no effect. Bits 8 (PREFETCH0) and 9 (PREFETCH1) of the bridge control register (PCI offset 3Eh, see Section 4.25) specify whether memory windows 0 and 1 are prefetchable or nonprefetchable. The memory base register or the memory limit register must be nonzero in order for the PCI1451A device to claim any memory transactions through CardBus memory windows (that is, these windows are not enabled by default to pass the first 4K bytes of memory to CardBus).

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Memory limit registers 0, 1															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Memory limit registers 0, 1															
Type	R/W	R/W	R/W	R/W	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Memory limit registers 0, 1**

Type: Read-only, Read/Write

Offset: 20h, 28h

Default: 0000 0000h

4.21 I/O Base Registers 0, 1

The I/O base registers indicate the lower address of a PCI I/O address range. These registers are used by the PCI1451A device to determine when to forward an I/O transaction to the CardBus bus and when to forward a CardBus cycle to the PCI bus. The lower 16 bits of this register locate the bottom of the I/O window within a 64-Kbyte page, and the upper 16 bits (31–16) are all 0s which locate this 64-Kbyte page in the first page of the 32-bit PCI I/O address space.

Bits 31–16 and bits 1–0 are read-only and always return 0s, forcing I/O windows to be aligned on a natural doubleword boundary in the first 64-Kbyte page of PCI I/O address space. These I/O windows are enabled when either the I/O base register or the I/O limit register are nonzero. The I/O windows are not enabled by default to pass the first doubleword of I/O to CardBus.

Either the I/O base or the I/O limit register must be nonzero to enable any I/O transactions.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	I/O base registers 0, 1															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	I/O base registers 0, 1															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **I/O base registers 0, 1**

Type: Read-only, Read/Write

Offset: 2Ch, 34h

Default: 0000 0000h

4.22 I/O Limit Registers 0, 1

The I/O limit registers indicate the upper address of a PCI I/O address range. These registers are used by the PCI1451A device to determine when to forward an I/O transaction to the CardBus bus and when to forward a CardBus cycle to the PCI bus. The lower 16 bits of this register locate the top of the I/O window within a 64-Kbyte page, and the upper 16 bits are a page register which locates this 64-Kbyte page in 32-bit PCI I/O address space. Bits 15–2 are read/write and allow the I/O limit address to be located anywhere in the 64-Kbyte page (indicated by bits 31–16 of the appropriate I/O base register) on doubleword boundaries.

Bits 31–16 are read-only and always return 0s when read. The page is set in the I/O base register. Bits 1–0 are read-only and always return 0s, forcing I/O windows to be aligned on a natural doubleword boundary. Writes to read-only bits have no effect. The PCI1451A device assumes that the lower 2 bits of the limit address are 1s.

These I/O windows are enabled when either the I/O base register or the I/O limit register are nonzero. The I/O windows are not enabled by default to pass the first doubleword of I/O to CardBus.

Either the I/O base or the I/O limit register must be nonzero to enable any I/O transactions.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	I/O limit registers 0, 1															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	I/O limit registers 0, 1															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **I/O limit registers 0, 1**
 Type: Read-only, Read/Write
 Offset: 30h, 38h
 Default: 0000 0000h

4.23 Interrupt Line Register

The interrupt line register communicates interrupt line routing information to the host system. This register is not used by the PCI1451A device, because there are many programmable interrupt signaling options. This register is considered reserved; however, host software can read and write to this register. Each PCI1451A function has an interrupt line register.

Bit	7	6	5	4	3	2	1	0
Name	Interrupt line							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	1	1	1	1	1	1	1	1

Register: **Interrupt line**
 Type: Read/Write
 Offset: 3Ch
 Default: FFh

4.24 Interrupt Pin Register

The value read from this register is function dependent and depends on bit 29 (INTRTIE) bit in the system control register (PCI offset 80h, see Section 4.29) and bits 2 and 1 (INTMODE field) in the device control register (PCI offset 92h, see Section 4.39). When the INTRTIE bit is set, this register will read 01h ($\overline{\text{INTA}}$) for both functions. The PCI1451A device defaults to signaling PCI and IRQ interrupts through the IRQSER serial interrupt terminal. See Table 4–6 for a complete description of the register contents.

PCI function 0

Bit	7	6	5	4	3	2	1	0
Name	Interrupt pin – PCI function 0							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	1

PCI function 1

Bit	7	6	5	4	3	2	1	0
Name	Interrupt pin – PCI function 1							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	1	0

Register: **Interrupt pin**
 Type: Read-only
 Offset: 3Dh
 Default: The default depends on the interrupt signaling mode.

Table 4–6. Interrupt Pin Register Cross Reference

INTERRUPT SIGNALING MODE	INTRTIE BIT	INTPIN FUNCTION 0	INTPIN FUNCTION 1
Parallel PCI interrupts only	0	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)
Parallel IRQ & parallel PCI interrupts	0	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)
IRQ serialized (IRQSER) & parallel PCI Interrupts	0	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)
IRQ & PCI serialized (IRQSER) interrupts (default)	0	01h ($\overline{\text{INTA}}$)	02h ($\overline{\text{INTB}}$)
Parallel PCI interrupts only	1	01h ($\overline{\text{INTA}}$)	01h ($\overline{\text{INTA}}$)
Parallel IRQ & parallel PCI interrupts	1	01h ($\overline{\text{INTA}}$)	01h ($\overline{\text{INTA}}$)
IRQ serialized (IRQSER) & parallel PCI interrupts	1	01h ($\overline{\text{INTA}}$)	01h ($\overline{\text{INTA}}$)
IRQ & PCI serialized (IRQSER) interrupts (default)	1	01h ($\overline{\text{INTA}}$)	01h ($\overline{\text{INTA}}$)

4.25 Bridge Control Register

The bridge control register provides control over various PCI1451A bridging functions. Bit 5 in this register is global in nature and is accessed only through function 0. See Table 4–7 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Bridge control															
Type	R	R	R	R	R	R/W	R/W	R/W	R/W	R/W	R/W	R	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0

Register: **Bridge control**
 Type: Read-only, Read/Write
 Offset: 3Eh (Function 0, 1)
 Default: 0340h

Table 4–7. Bridge Control Register Description

BIT	SIGNAL	TYPE	FUNCTION
15–11	RSVD	R	Reserved. Bits 15–11 return 0s when read.
10	POSTEN	R/W	Write posting enable. Enables write posting to and from the CardBus sockets. Write posting enables posting of write data on burst cycles. Operating with write posting disabled inhibits performance on burst cycles. Note that bursted write data can be posted, but various write transactions can not. Bit 10 is socket dependent and is not shared between functions 0 and 1.
9	PREFETCH1	R/W	Memory window 1 type. This bit specifies whether or not memory window 1 is prefetchable. Bit 9 is socket dependent. This bit is encoded as: 0 = Memory window 1 is nonprefetchable. 1 = Memory window 1 is prefetchable (default).
8	PREFETCH0	R/W	Memory window 0 type. This bit specifies whether or not memory window 0 is prefetchable. Bit 8 is encoded as: 0 = Memory window 0 is nonprefetchable. 1 = Memory window 0 is prefetchable (default).
7	INTR	R/W	PCI interrupt – IREQ routing enable. Bit 7 selects whether PC Card functional interrupts are routed to PCI interrupts or to the IRQ specified in the ExCA registers. 0 = Functional interrupts are routed to PCI interrupts (default). 1 = Functional interrupts are routed by ExCA registers.
6	CRST	R/W	CardBus reset. When bit 6 is set, \overline{CRST} is asserted on the CardBus interface. \overline{CRST} also can be asserted by passing a \overline{PRST} assertion to CardBus. 0 = \overline{CRST} is deasserted. 1 = \overline{CRST} is asserted (default).
5	MABTMODE	R/W	Master abort mode. Bit 5 controls how the PCI1451A device responds to a master abort when the PCI1451A device is an initiator on the CardBus interface. This bit is common between each socket. 0 = Master aborts are not reported (default). 1 = Signal target abort on PCI and signal \overline{SERR} , if enabled.
4	RSVD	R	Reserved. Bit 4 returns 0 when read.
3	VGAEN	R/W	VGA enable. Bit 3 affects how the PCI1451A device responds to VGA addresses. When this bit is set, accesses to VGA addresses are forwarded.
2	ISAEN	R/W	ISA mode enable. Bit 2 affects how the PCI1451A device passes I/O cycles within the 64-Kbyte ISA range. This bit is not common between sockets. When this bit is set, the PCI1451A device does not forward the last 768 bytes of each 1K I/O range to CardBus.
1	CSERREN	R/W	\overline{CSERR} enable. Bit 1 controls the response of the PCI1451A device to \overline{CSERR} signals on the CardBus bus. This bit is separate for each socket. 0 = \overline{CSERR} is not forwarded to PCI \overline{SERR} . 1 = \overline{CSERR} is forwarded to PCI \overline{SERR} .
0	CPERREN	R/W	CardBus parity error response enable. Bit 0 controls the response of the PCI1451A device to CardBus parity errors. This bit is separate for each socket. 0 = CardBus parity errors are ignored. 1 = CardBus parity errors are reported using \overline{CPERR} .

4.26 Subsystem Vendor ID Register

The subsystem vendor ID register is used for system and option-card identification purposes and may be required for certain operating systems. This register is read-only or read/write, depending on the setting of bit 5 (SUBSYSRW) in the system control register (PCI offset 80h, see Section 4.29).

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Subsystem vendor ID															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Subsystem vendor ID**
 Type: Read-only (Read/Write if enabled by SUBSYSRW)
 Offset: 40h (Functions 0, 1)
 Default: 0000h

4.27 Subsystem ID Register

The subsystem ID register is used for system and option-card identification purposes and may be required for certain operating systems. This register is read-only or read/write, depending on the setting of bit 5 (SUBSYSRW) in the system control register (PCI offset 80h, see Section 4.29). If an EEPROM is present, the subsystem ID and subsystem vendor ID are loaded from the EEPROM after a reset.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Subsystem ID															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Subsystem ID**
 Type: Read-only (Read/Write if enabled by SUBSYSRW)
 Offset: 42h (Functions 0, 1)
 Default: 0000h

4.28 PC Card 16-Bit I/F Legacy Mode Base Address Register

The PCI1451A device supports the index/data scheme of accessing the ExCA registers, which is mapped by this register. An address written to this register is the address for the index register and the address+1 is the data address. Using this access method, applications requiring index/data ExCA access can be supported. The base address can be mapped anywhere in 32-bit I/O space on a word boundary; hence, bit 0 is read-only, returning 1 when read. See Chapter 5, *ExCA Compatibility Registers*, for register offsets.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	PC Card 16-bit I/F legacy mode base address															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	PC Card 16-bit I/F legacy mode base address															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Register: **PC Card 16-bit I/F legacy mode base address**
 Type: Read-only, Read/Write
 Offset: 44h (Functions 0, 1)
 Default: 0000 0001h

4.29 System Control Register

System-level initializations are performed through programming this doubleword register. Bits 31–29, 27, 26, 24, 15, 14, 6–3, 1, and 0 are global in nature and are accessed only through function 0. See Table 4–8 for a complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	System control															
Type	R/W	R/W	R/W	R	R/W	R/W	R/W	R/W	R	R/W						
Default	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	System control															
Type	R/W	R/W	R	R	R	R	R	R	R	R/W	R/W	R/W	R/W	R	R/W	R/W
Default	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0

Register: **System control**
 Type: Read-only, Read/Write
 Offset: 80h (Functions 0, 1)
 Default: 0044 9060h

Table 4–8. System Control Register Description

BIT	SIGNAL	TYPE	FUNCTION
31–30	SER_STEP	R/W	Serialized PCI interrupt routing step. Bits 31 and 30 configure the serialized PCI interrupt stream signaling and accomplish an even distribution of interrupts signaled on the four PCI interrupt slots. These bits are <u>global to both PCI1451A functions</u> . 00 = <u>INTA/INTB</u> signal in <u>INTA/INTB</u> IRQSER slots (default) 01 = <u>INTA/INTB</u> signal in <u>INTB/INTC</u> IRQSER slots 10 = <u>INTA/INTB</u> signal in <u>INTC/INTD</u> IRQSER slots 11 = <u>INTA/INTB</u> signal in <u>INTD/INTA</u> IRQSER slots
29	INTRTIE	R/W	Tie internal PCI interrupts. When bit 29 is set, the <u>INTA</u> and <u>INTB</u> signals are tied together internally and are signaled as <u>INTA</u> . <u>INTA</u> then can be shifted by using bits 31 and 30 (SER_STEP). This bit is <u>global to both PCI1451A functions</u> . 0 = <u>INTA</u> and <u>INTB</u> are not tied together internally (default). 1 = <u>INTA</u> and <u>INTB</u> are tied together internally.
28	RSVD	R	Reserved. Bit 28 returns 0 when read.
27	P2CCLK	R/W	P2C power switch CLOCK. Bit 27 determines whether the CLOCK terminal (terminal U12) is an input that requires an external clock source or if this terminal is an output that uses the internal oscillator. 0 = CLOCK terminal (terminal U12) is an input (default) (disabled). 1 = CLOCK terminal is an output, the PCI1451A generated CLOCK. A 43-kΩ pulldown resistor should be tied to this terminal.
26	SMIRROUTE	R/W	SMI interrupt routing. Bit 26 is shared between functions 0 and 1, and selects whether IRQ2 or CSC is signaled when a write occurs to power a PC Card socket. 0 = PC Card power change interrupts are routed to IRQ2 (default). 1 = A CSC interrupt is generated on PC Card power changes.
25	SMISTATUS	R/W	SMI interrupt status. This socket dependent bit is set when bit 24 (SMIENB) is set and a write occurs to set the socket power. Writing a 1 to bit 25 clears the status. 0 = SMI interrupt is signaled. 1 = SMI interrupt is not signaled.
24	SMIENB	R/W	SMI interrupt mode enable. When bit 24 is set and a write to the socket power control occurs, the SMI interrupt signaling is enabled and generates an interrupt. This bit is shared and defaults to 0 (disabled). 0 = SMI interrupt mode is disabled (default). 1 = SMI interrupt mode is enabled.
23	RSVD	R	Reserved. Bit 23 returns 0 when read.

Table 4–8. System Control Register Description (continued)

BIT	SIGNAL	TYPE	FUNCTION
22	CBRSVD	R/W	CardBus reserved terminals signaling. When a CardBus card is inserted and bit 22 is set, the RSVD CardBus terminals are driven low. When bit 22 is 0, these signals are placed in a high-impedance state. 0 = Place the CardBus RSVD terminals in a high-impedance state. 1 = Drive the CardBus RSVD terminals low (default).
21	VCCPROT	R/W	V _{CC} protection enable. This bit is socket dependent. 0 = V _{CC} protection is enabled for 16-bit cards (default). 1 = V _{CC} protection is disabled for 16-bit cards.
20	REDUCEZV	R/W	Reduced ZV enable. When bit 20 is enabled, terminals ADDR25–ADDR22 of the card interface for PC Card 16 cards are placed in the high-impedance state. This bit is encoded as: 0 = Reduced ZV is disabled (default). 1 = Reduced ZV is enabled.
19	CDREQEN	R/W	PC/PCI DMA card enable. When bit 19 is set, the PCI1451A device allows 16-bit PC Cards to request PC/PCI DMA using the <u>DREQ</u> signaling. <u>DREQ</u> is selected through the socket DMA register 0 (PCI offset 94h, see Section 4.41). 0 = Ignore DREQ signaling from PC Cards (default). 1 = Signal DMA request on DREQ.
18–16	CDMACHAN	R/W	PC/PCI DMA channel assignment. Bits 18–16 are encoded as: 0–3 = 8-bit DMA channels 4 = PCI master; not used (default) 5–7 = 16-bit DMA channels
15	MRBURSTDN	R/W	Memory-read burst-enable downstream. When bit 15 is set, memory-read transactions are allowed to burst downstream. 0 = Downstream memory-read burst is disabled. 1 = Downstream memory-read burst is enabled (default).
14	MRBURSTUP	R/W	Memory-read burst-enable upstream. When bit 14 is set, the PCI1451A device allows memory-read transactions to burst upstream. 0 = Upstream memory-read burst is disabled (default). 1 = Upstream memory-read burst is enabled.
13	SOCACTIVE	R	Socket activity status. When set, bit 13 indicates access has been performed to or from a PC Card, and is cleared upon read of this status bit. This bit is socket-dependent. 0 = No socket activity (default) 1 = Socket activity
12	RSVD	R	Reserved. This bit returns 1 when read. This is the clamping voltage bit in functions 0 and 1.
11	PWRSTREAM	R	Power stream in progress status bit. When set, bit 11 indicates that a power stream to the power switch is in progress and a powering change has been requested. This bit is cleared when the power stream is complete. 0 = Power stream is complete and delay has expired. 1 = Power stream is in progress.
10	DELAYUP	R	Power-up delay in progress status bit. When set, bit 10 indicates that a power-up stream has been sent to the power switch and proper power may not yet be stable. This bit is cleared when the power-up delay has expired. 0 = Power-up delay has expired. 1 = Power-up stream is sent to switch. Power might not be stable.
9	DELAYDOWN	R	Power-down delay in progress status bit. When set, bit 9 indicates that a power-down stream has been sent to the power switch and proper power may not yet be stable. This bit is cleared when the power-down delay has expired. 0 = Power-down delay has expired. 1 = Power-down stream is sent to switch. Power might not be stable.
8	INTERROGATE	R	Interrogation in progress. When set, bit 8 indicates an interrogation is in progress and clears when the interrogation completes. This bit is socket dependent. 0 = Interrogation is not in progress (default). 1 = Interrogation is in progress.
7	RSVD	R	Reserved. Bit 7 returns 0 when read.

Table 4–8. System Control Register Description (continued)

BIT	SIGNAL	TYPE	FUNCTION
6	PWRSAVINGS	R/W	Power savings mode enable. When bit 6 is set, the PCI1451A device consumes less power with no performance loss. This bit is shared between the two PCI1451A functions. 0 = Power savings mode is disabled. 1 = Power savings mode is enabled (default).
5	SUBSYSRW	R/W	Subsystem ID (PCI offset 42h, see Section 4.27), subsystem vendor ID (PCI offset 40h, see Section 4.26), and the ExCA identification and revision (ExCA offset 00h, see Section 5.1) registers read/write enable. Bit 5 is shared by functions 0 and 1. 0 = Subsystem ID, subsystem vendor ID, and ExCA identification and revision registers are read/write. 1 = Subsystem ID, subsystem vendor ID, and ExCA identification and revision registers are read-only (default).
4	CB_DPAR	R/W	CardBus data parity $\overline{\text{SERR}}$ signaling enable. 0 = CardBus data parity is not signaled on PCI $\overline{\text{SERR}}$ (default). 1 = CardBus data parity is signaled on PCI $\overline{\text{SERR}}$.
3	CDMA_EN	R/W	PC/PCI DMA enable. Enables PC/PCI DMA when set. When PC/PCI DMA is enabled, $\overline{\text{PCREQ}}$ and $\overline{\text{PCGNT}}$ should be routed to a multifunction routing terminal. See multifunction routing status register (PCI offset 8Ch, see Section 4.36) for options. 0 = Centralized DMA is disabled (default). 1 = Centralized DMA is enabled.
2	RSVD	R	Reserved. Bit 2 returns 0 when read.
1	KEEPCLK	R/W	Keep clock. When bit 1 is set, the PCI1451A device always follows $\overline{\text{CLKRUN}}$ protocol to maintain the system PCLK and the CCLK (CardBus clock). This bit is global to the PCI1451A functions. 0 = Allow system PCLK and CCLK to stop (default). 1 = Never allow system PCLK or CCLK clock to stop. Note that the functionality of this bit has changed versus the PCI12XX series of TI CardBus controllers. In these CardBus controllers, setting this bit would only maintain the PCI clock, not the CCLK. In the PCI1451A device, setting this bit maintains both the PCI clock and the CCLK.
0	RIMUX	R/W	$\overline{\text{PME}}/\overline{\text{RI_OUT}}$ select bit. When bit 0 is 1, the $\overline{\text{PME}}$ signal is routed to the $\overline{\text{RI_OUT}}/\overline{\text{PME}}$ terminal. When this bit is 0 and bit 7 (RIENB) of the card control register (PCI offset 91h, see Section 4.38) is 1, the $\overline{\text{RI_OUT}}$ signal is routed to the $\overline{\text{RI_OUT}}/\overline{\text{PME}}$ terminal. If this bit is 0 and bit 7 (RIENB) of the card control register is 0, the output on the $\overline{\text{RI_OUT}}/\overline{\text{PME}}$ terminal is placed in a high-impedance state. This terminal is encoded as: 0 = $\overline{\text{RI_OUT}}$ signal is routed to the $\overline{\text{RI_OUT}}/\overline{\text{PME}}$ terminal if bit 7 of the card control register is 1 (default). 1 = $\overline{\text{PME}}$ signal is routed to the $\overline{\text{RI_OUT}}/\overline{\text{PME}}$ terminal of the PCI1451A controller.

4.30 Multimedia Control Register

The multimedia control register provides port mapping for the PCI1451A ZV/data ports. See Section 3.4.3, *Zoomed-Video Support*, for details on the PCI1451A ZV support. Access this register only through function 0. See Table 4–9 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	Multimedia control							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **Multimedia control**
 Type: Read/Write
 Offset: 84h (Functions 0, 1)
 Default: 00h

Table 4–9. Multimedia Control Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	ZVOUTEN	R/W	ZV output enable. Bit 7 enables the output for the PCI1451A outsourcing ZV terminals. When this bit is cleared, these terminals are in a high-impedance state. 0 = PCI1451A ZV output terminals are disabled (default). 1 = PCI1451A ZV output terminals are enabled.
6	PORTSEL	R/W	ZV port select. Bit 6 controls the multiplexing control over which PC Card ZV port data is driven to the outsourcing PCI1451A ZV port. 0 = Output card 0 ZV if enabled (default) 1 = Output card 1 ZV if enabled
5	ZVAUTO	R/W	ZV auto-detect. Bit 5 enables the ZV auto-detect feature. This bit is encoded as: 0 = ZV auto-detect is disabled (default). 1 = ZV auto-detect is enabled.
4–2	AUTODETECT	R/W	Auto-detect priority encoding. Bits 4–2 have meaning only if bit 5 (ZVAUTO) is enabled. If bit 5 is enabled, bits 4–2 are encoded as follows: 000 = Slot A, Slot B, External Source 001 = Slot A, External Source, Slot B 010 = Slot B, Slot A, External Source 011 = Slot B, External Source, Slot A 100 = External Source, Slot A, Slot B 101 = External Source, Slot B, Slot A 110 = Reserved 111 = Reserved
1	ZVEN1	R/W	PC Card 1 ZV mode enable. Enables the ZV mode for socket 1. When bit 1 set, the PCI1451A device inputs ZV data from the PC Card interface and disables output drivers on ZV terminals. 0 = PC Card 1 ZV is disabled (default). 1 = PC Card 1 ZV is enabled.
0	ZVEN0	R/W	PC Card 0 ZV mode enable. Enables the ZV mode for socket 0. When bit 0 set, the PCI1451A device inputs ZV data from the PC Card interface and disables output drivers on ZV terminals. 0 = PC Card 0 ZV is disabled (default). 1 = PC Card 0 ZV is enabled.

4.31 General Status Register

The general status register provides the general device status information. The status of the serial EEPROM interface is provided through this register. Bits 2–0 are global in nature and are accessed only through function 0. See Table 4–10 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	General status							
Type	R	R	R	R	R	R	RC	R
Default	0	0	0	0	0	X	0	0

Register: **General status**
 Type: Read-only, Read/Clear
 Offset: 85h (Functions 0)
 Default: 00h

Table 4–10. General Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–3	RSVD	R	Reserved. Bits 7–3 return 0s when read.
2	EEDETECT	R	Serial EEPROM detect. When bit 2 is cleared, it indicates that the PCI1451A serial EEPROM circuitry has detected an EEPROM. A pullup resistor must be implemented on the SDA terminal for this bit to be set. This status bit is encoded as: 0 = EEPROM is not detected (default). 1 = EEPROM is detected.
1	DATAERR	RC	Serial EEPROM data error status. Bit 1 indicates when a data error occurs on the serial EEPROM interface. This bit is set due to a missing acknowledge. This bit is cleared by a writeback of 1. 0 = No error is detected. (default) 1 = Data error is detected.
0	EEBUSY	R	Serial EEPROM busy status. Bit 0 indicates the status of the PCI1451A serial EEPROM circuitry. This bit is set during the loading of the subsystem ID value. 0 = Serial EEPROM circuitry is not busy (default). 1 = Serial EEPROM circuitry is busy.

4.32 General-Purpose Event Status Register

The general-purpose event status register contains status bits that are set when general events occur and can be programmed to generate general-purpose event signaling through $\overline{\text{GPE}}$. See Table 4–11 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	General-purpose event status							
Type	RCU	RCU	R	R	RCU	RCU	RCU	RCU
Default	0	0	0	0	0	0	0	0

Register: **General-purpose event status**
 Type: Read/Clear/Update
 Offset: 88h
 Default: 00h

Table 4–11. General-Purpose Event Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	PWR_STS	RCU	Power change status. Bit 7 is set when software changes the V_{CC} or V_{PP} power state of either socket.
6	VPP12_STS	RCU	12-V V_{PP} request status. Bit 6 is set when software has changed the requested V_{PP} level to or from 12 V for either socket.
5–4	RSVD	R	Reserved. Bits 5 and 4 return 0s when read.
3	GP3_STS	RCU	GPI3 status. Bit 3 is set on a change in status of the MFUNC3 terminal input level if configured as a general-purpose input, GPI3.
2	GP2_STS	RCU	GPI2 status. Bit 2 is set on a change in status of the MFUNC2 terminal input level if configured as a general-purpose input, GPI2.
1	GP1_STS	RCU	GPI1 status. Bit 1 is set on a change in status of the MFUNC1 terminal input level if configured as a general-purpose input, GPI1.
0	GP0_STS	RCU	GPI0 status. Bit 0 is set on a change in status of the MFUNC0 terminal input level if configured as a general-purpose input, GPI0.

4.33 General-Purpose Event Enable Register

The general-purpose event enable register contains bits that are set to enable $\overline{\text{GPE}}$ signals. See Table 4–12 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	General-purpose event enable							
Type	R/W	R/W	R	R	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **General-purpose event enable**
 Type: Read-only, Read/Write
 Offset: 89h
 Default: 00h

Table 4–12. General-Purpose Event Enable Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	PWR_EN	R/W	Power change $\overline{\text{GPE}}$ enable. When bit 7 is set, $\overline{\text{GPE}}$ is signaled on PWR_STS events.
6	VPP12_EN	R/W	12-V V_{PP} $\overline{\text{GPE}}$ enable. When bit 6 is set, $\overline{\text{GPE}}$ is signaled on VPP12_STS events.
5–4	RSVD	R	Reserved. Bits 5 and 4 return 0s when read.
3	GP3_EN	R/W	GPI3 $\overline{\text{GPE}}$ enable. When bit 3 is set, $\overline{\text{GPE}}$ is signaled on GP3_STS events.
2	GP2_EN	R/W	GPI2 $\overline{\text{GPE}}$ enable. When bit 2 is set, $\overline{\text{GPE}}$ is signaled on GP2_STS events.
1	GP1_EN	R/W	GPI1 $\overline{\text{GPE}}$ enable. When bit 1 is set, $\overline{\text{GPE}}$ is signaled on GP1_STS events.
0	GP0_EN	R/W	GPI0 $\overline{\text{GPE}}$ enable. When bit 0 is set, $\overline{\text{GPE}}$ is signaled on GP0_STS events.

4.34 General-Purpose Input Register

The general-purpose input register contains GPI terminal status. See Table 4–13 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	General-purpose input							
Type	R	R	R	R	RU	RU	RU	RU
Default	0	0	0	0	x	x	x	x

Register: **General-purpose input**
 Type: Read/Update
 Offset: 8Ah
 Default: 00h

Table 4–13. General-Purpose Input Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–4	RSVD	R	Reserved. Bits 7–4 return 0s when read.
3	GPI3_DATA	RU	GPI3 data input. Bit 3 represents the logical value of the data input from GPI3.
2	GPI2_DATA	RU	GPI2 data input. Bit 2 represents the logical value of the data input from GPI2.
1	GPI1_DATA	RU	GPI1 data input. Bit 1 represents the logical value of the data input from GPI1.
0	GPI0_DATA	RU	GPI0 data input. Bit 0 represents the logical value of the data input from GPI0.

4.35 General-Purpose Output Register

The general-purpose output register is used to drive the GPO3–GPO0 outputs. See Table 4–14 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	General-purpose output							
Type	R	R	R	R	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **General-purpose output**
 Type: Read-only, Read/Write
 Offset: 8Bh
 Default: 00h

Table 4–14. General-Purpose Output Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–4	RSVD	R	Reserved. Bits 7–4 return 0s when read.
3	GPO3_DATA	R/W	Bit 3 represents the logical value of the data driven to GPO3.
2	GPO2_DATA	R/W	Bit 2 represents the logical value of the data driven to GPO2.
1	GPO1_DATA	R/W	Bit 1 represents the logical value of the data driven to GPO1.
0	GPO0_DATA	R/W	Bit 0 represents the logical value of the data driven to GPO0.

4.37 Retry Status Register

The retry status register enables the retry time-out counters and displays the retry expiration status. The flags are set when the PCI1451A device retries a PCI or CardBus master request and the master does not return within 2¹⁵ PCI clock cycles. The flags are cleared by writing a 1 to the bit. These bits are expected to be incorporated into the command register (PCI offset 04h, see Section 4.4), status register (PCI offset 06h, see Section 4.5), and bridge control register (PCI offset 3Eh, see Section 4.25) by the PCI SIG. Access this register only through function 0. See Table 4–16 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	Retry status							
Type	R/W	R/W	RC	R	RC	R	RC	R
Default	1	1	0	0	0	0	0	0

Register: **Retry status**
 Type: Read-only, Read/Write, Read/Clear
 Offset: 90h (Functions 0, 1)
 Default: C0h

Table 4–16. Retry Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	PCIRETRY	R/W	PCI retry time-out counter enable. Bit 7 is encoded as: 0 = PCI retry counter is disabled. 1 = PCI retry counter is enabled (default).
6	CBRETRY	R/W	CardBus retry time-out counter enable. Bit 6 is encoded as: 0 = CardBus retry counter is disabled. 1 = CardBus retry counter is enabled (default).
5	TEXP_CBB	RC	CardBus target B retry expired. Write a 1 to clear this bit. 0 = Inactive (default) 1 = Retry has expired.
4	RSVD	R	Reserved. Bit 4 returns 0 when read.
3	TEXP_CBA	RC	CardBus target A retry expired. Write a 1 to clear this bit. 0 = Inactive (default) 1 = Retry has expired.
2	RSVD	R	Reserved. Bit 2 returns 0 when read.
1	TEXP_PCI	RC	PCI target retry expired. Write a 1 to clear this bit. 0 = Inactive (default) 1 = Retry has expired.
0	RSVD	R	Reserved. Bit 0 returns 0 when read.

4.38 Card Control Register

The card control register is provided for PCI1130 compatibility. The contents provide the PC Card function interrupt flag (IFG) and an alias for bit 0 (ZVEN0) and bit 1 (ZVEN1) found in the PCI1451A multimedia control register (PCI offset 84h, see Section 4.30). When this register is accessed by function 0, the ZVEN0 bit will alias with bit 6 (ZVENABLE). When this register is accessed by function 1, the ZVEN1 bit will alias with bit 6 (ZVENABLE). Setting bit 6 only places the PC Card socket interface ZV terminals in a high-impedance state, but does not enable the PCI1451A device to drive ZV data onto the ZV terminals.

The $\overline{\text{RI_OUT}}$ signal is enabled through this register, and bit 7 (RIENB) is shared between functions 0 and 1. See Table 4–17 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	Card control							
Type	R/W	R/W	R/W	R	R	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **Card control**
 Type: Read-only, Read/Write
 Offset: 91h
 Default: 00h

Table 4–17. Card Control Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	RIENB	R/W	Ring indicate enable. When bit 7 is 1, the $\overline{\text{RI_OUT}}$ output is enabled. This bit is global in nature and should be accessed only through function 0. This bit defaults to 0.
6	ZVENABLE	R/W	Compatibility ZV mode enable. When bit 6 is 1, the corresponding PC Card socket interface ZV terminals enter a high-impedance state. This bit defaults to 0.
5	RSVD	R/W	Reserved.
4–3	RSVD	R	Reserved. Bits 4 and 3 return 0s when read.
2	AUD2MUX	R/W	CardBus audio-to-MFUNC. When bit 2 is set, the CAUDIO CardBus signal is routed through an MFUNC terminal. If this bit is set for both functions, function 0 is routed. 0 = CAUDIO is set to CAUDPWM on MFUNC terminal (default). 1 = CAUDIO is not routed.
1	SPKROUTEN	R/W	Speaker output enable. When bit 1 is 1, it enables $\overline{\text{SPKR}}$ on the PC Card and routes it to SPKROUT on the PCI bus. $\overline{\text{SPKR}}$ from socket 0 is XORed with $\overline{\text{SPKR}}$ from socket 1 and sent to SPKROUT. The SPKROUT terminal only drives data when either function's SPKROUTEN bit is set. This bit is encoded as: 0 = $\overline{\text{SPKR}}$ to SPKROUT is not enabled (default). 1 = $\overline{\text{SPKR}}$ to SPKROUT is enabled.
0	IFG	R/W	Interrupt flag. Bit 0 is the interrupt flag for 16-bit I/O PC Cards and for CardBus cards. This bit is set when a functional interrupt is signaled from a PC Card interface, and is socket dependent (that is, not global). Write back a 1 to clear this bit. 0 = No PC Card functional interrupt is detected (default). 1 = PC Card functional interrupt is detected.

4.39 Device Control Register

The device control register is provided for PCI1130 compatibility. It contains bits that are shared between functions 0 and 1. The interrupt mode select and the socket-capable force bits are programmed through this register. Bits 6 and 3–0 are global in nature and should be accessed only through function 0. See Table 4–18 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	Device control							
Type	R/W	R/W	R/W	R	R/W	R/W	R/W	R/W
Default	0	1	1	0	0	1	1	0

Register: **Device control**
 Type: Read-only, Read/Write
 Offset: 92h (Functions 0, 1)
 Default: 66h

Table 4–18. Device Control Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	SKTPWR_LOCK	R/W	Socket power lock bit. When bit 7 is set to 1, software cannot power down the PC Card socket while in D3. This may be necessary to support wake on LAN or RING if the operating system is programmed to power down a socket when the CardBus controller is placed in the D3 state.
6	3VCAPABLE	R/W	3-V socket capable force bit. 0 = Not 3-V capable 1 = 3-V capable (default)
5	IO16R2	R/W	Diagnostic bit. Bit 5 defaults to 1.
4	RSVD	R	Reserved. Bit 4 returns 0 when read. A write has no effect.
3	TEST	R/W	TI test bit. Write only 0 to this bit. This bit can be set to shorten the interrogation counter.
2–1	INTMODE	R/W	Interrupt signaling mode. Bits 2–1 select the interrupt signaling mode. The interrupt signaling mode bits are encoded: 00 = Parallel PCI interrupts only 01 = Reserved 10 = IRQ serialized interrupts & parallel PCI interrupts \overline{INTA} and \overline{INTB} 11 = IRQ & PCI serialized interrupts (default)
0	RSVD	R/W	Reserved. NAND tree enable bit. There is a NAND tree diagnostic structure in the PCI1451A device, and it tests only the terminals that are inputs or I/Os. Any output only terminal on the PCI1451A device is excluded from the NAND tree test.

4.40 Diagnostic Register

The diagnostic register is provided for internal Texas Instruments test purposes. See Table 4–19 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	Diagnostic							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	1	1	0	0	0	0	1

Register: **Diagnostic**
 Type: Read/Write
 Offset: 93h (Functions 0, 1)
 Default: 61h

Table 4–19. Diagnostic Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	TRUE_VAL	R/W	This bit defaults to 0. This bit is encoded as: 0 = Reads true values in vendor ID (PCI offset 00h, see Section 4.2) and device ID (PCI offset 02h, see Section 4.3) registers (default). 1 = Reads all 1s in reads to the PCI vendor ID and PCI device ID registers.
6	RSVD	R/W	Reserved.
5	CSC	R/W	CSC interrupt routing control 0 = CSC interrupts are routed to PCI if ExCA 803 (see Section 5.4) bit 4 = 1. 1 = CSC interrupts are routed to PCI if ExCA 805 (see Section 5.6) bits 7–4 = 0000b. (Default) In this case, the setting of ExCA 803 bit 4 is a don't care.
4	DIAG4	R/W	Diagnostic RETRY_DIS. Delayed transaction disable.
3	DIAG3	R/W	Diagnostic RETRY_EXT. Extends the latency from 16 to 64.
2	DIAG2	R/W	Diagnostic DISCARD_TIM_SEL_CB. Set = 2 ¹⁰ , Reset = 2 ¹⁵
1	DIAG1	R/W	Diagnostic DISCARD_TIM_SEL_PCI. Set = 2 ¹⁰ , Reset = 2 ¹⁵
0	ASYNC_CSC	R/W	Asynchronous interrupt generation. 0 = CSC interrupt is not generated asynchronously. 1 = CSC interrupt is generated asynchronously (default).

4.41 Socket DMA Register 0

Socket DMA register 0 provides control over the PC Card $\overline{\text{DREQ}}$ (DMA request) signaling. See Table 4–20 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket DMA register 0															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket DMA register 0															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **DMA socket register 0**
 Type: Read-only, Read/Write
 Offset: 94h (Functions 0, 1)
 Default: 0000 0000h

Table 4–20. Socket DMA Register 0 Description

BIT	SIGNAL	TYPE	FUNCTION
31–2	RSVD	R	Reserved. Bits 31–2 return 0s when read.
1–0	DREQPIN	R/W	DMA request ($\overline{\text{DREQ}}$) terminal. Bits 1 and 0 indicate which terminal on the 16-bit PC Card interface acts as the $\overline{\text{DREQ}}$ during DMA transfers. This field is encoded as: 00 = Socket not configured for DMA (default) 01 = $\overline{\text{DREQ}}$ uses $\overline{\text{SPKR}}$ 10 = $\overline{\text{DREQ}}$ uses $\overline{\text{IOIS16}}$ 11 = $\overline{\text{DREQ}}$ uses $\overline{\text{INPACK}}$

4.42 Socket DMA Register 1

Socket DMA register 1 provides control over the distributed DMA (DDMA) registers and the PCI portion of DMA transfers. The DMA base address locates the DDMA registers in a 16-byte region within the first 64K bytes of PCI I/O address space. Note that 32-bit transfers to the 16-bit PC Card interface are not supported; the maximum transfer possible to the PC Card interface is 16 bits. However, 32 bits of data are prefetched from the PCI bus, thus allowing back-to-back 16-bit transfers to the PC Card interface. See Table 4–21 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket DMA register 1															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket DMA register 1															
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **DMA socket register 1**
 Type: Read-only, Read/Write
 Offset: 98h (Functions 0, 1)
 Default: 0000 0000h

Table 4–21. Socket DMA Register 1 Description

BIT	SIGNAL	TYPE	FUNCTION
31–16	RSVD	R	Reserved. Bits 31–16 return 0s when read.
15–4	DMABASE	R/W	DMA base address. Locates the socket's DMA registers in PCI I/O space. This field represents a 16-bit PCI I/O address. The upper 16 bits of the address are hardwired to 0, forcing this window to within the lower 64K bytes of I/O address space. The lower 4 bits are hardwired to 0 and are included in the address decode. Thus, the window is aligned to a natural 16-byte boundary.
3	EXTMODE	R	Extended addressing. This feature is not supported by the PCI1451A device, and always returns a 0.
2–1	XFERSIZE	R/W	Transfer size. Bits 2 and 1 specify the width of the DMA transfer on the PC Card interface and are encoded as: 00 = Transfers are 8 bits (default). 01 = Transfers are 16 bits. 10 = Reserved 11 = Reserved
0	DDMAEN	R/W	DDMA registers decode enable. Enables the decoding of the distributed DMA registers based upon the value of bits 15–4 (DMABASE field). 0 = Disabled (default) 1 = Enabled

4.43 Capability ID Register

The capability ID register identifies the linked list item as the register for PCI power management. The register returns 01h when read, which is the unique ID assigned by the PCI SIG for the PCI location of the capabilities pointer and the value.

Bit	7	6	5	4	3	2	1	0
Name	Capability ID							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	1

Register: **Capability ID**
Type: Read-only
Offset: A0h
Default: 01h

4.44 Next Item Pointer Register

The contents of this register indicate the next item in the linked list of the PCI power management capabilities. Because the PCI1451A functions only include one capabilities item, this register returns 0s when read.

Bit	7	6	5	4	3	2	1	0
Name	Next item pointer							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0

Register: **Next item pointer**
Type: Read-only
Offset: A1h
Default: 00h

4.45 Power Management Capabilities Register

The power management capabilities register contains information on the capabilities of the PC Card function related to power management. Both PCI1451A CardBus bridge functions support D0, D1, D2, and D3 power states. See Table 4–22 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Power management capabilities															
Type	R/W	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	1

Register: **Power management capabilities**
 Type: Read-only, Read/Write
 Offset: A2h (Functions 0, 1)
 Default: FE11h

Table 4–22. Power Management Capabilities Register Description

BIT	SIGNAL	TYPE	FUNCTION
15	PME_Support	R/W	$\overline{\text{PME}}$ support. This 5-bit field indicates the power states from which the PCI1451A functions can assert $\overline{\text{PME}}$. A 0b (zero) for any bit indicates that the function cannot assert the $\overline{\text{PME}}$ signal while in that power state. These five bits return 11111b when read. Each of these bits is described below: Bit 15 defaults to a 1 indicating the $\overline{\text{PME}}$ signal can be asserted from the D3 _{cold} state. This bit is read/write because wake-up support from D3 _{cold} is contingent on the system providing an auxiliary power source to the V _{CC} terminals. If the system designer chooses not to provide an auxiliary power source to the V _{CC} terminals for D3 _{cold} wake-up support, the BIOS should write a 0 to this bit.
14–11	PME_Support	R	Bit 14 contains the value 1 to indicate that the $\overline{\text{PME}}$ signal can be asserted from the D3 _{hot} state. Bit 13 contains the value 1 to indicate that the $\overline{\text{PME}}$ signal can be asserted from the D2 state. Bit 12 contains the value 1 to indicate that the $\overline{\text{PME}}$ signal can be asserted from the D1 state. Bit 11 contains the value 1 to indicate that the $\overline{\text{PME}}$ signal can be asserted from the D0 state.
10	D2_Support	R	D2 support. Bit 10 returns a 1 when read, indicating that the CardBus function supports the D2 device power state.
9	D1_Support	R	D1 support. Bit 9 returns a 1 when read, indicating that the CardBus function supports the D1 device power state.
8–6	RSVD	R	Reserved. Bits 8–6 return 000b when read.
5	DSI	R	Device specific initialization. Bit 5 returns 0 when read.
4	AUX_PWR	R	Auxiliary power source. Bit 4 is meaningful only if bit 15 (PME_Support, D3 _{cold}) is set. When bit 4 is set, it indicates that support for $\overline{\text{PME}}$ in D3 _{cold} requires auxiliary power supplied by the system by way of a proprietary delivery vehicle. When bit 4 is 0, it indicates that the function supplies its own auxiliary power source.
3	PMECLK	R	When bit 3 is 1, it indicates that the function relies on the presence of the PCI clock for $\overline{\text{PME}}$ operation. When bit 3 is 0, it indicates that no PCI clock is required for the function to generate $\overline{\text{PME}}$.
2–0	VERSION	R	Version. Bits 2–0 return 001b when read, indicating that there are four bytes of general-purpose power management (PM) registers as described in the <i>PCI Bus Power Management Interface Specification</i> .

4.46 Power Management Control/Status Register

The power management control/status register determines and changes the current power state of the PCI1451A CardBus function. The contents of this register are not affected by the internally-generated reset caused by the transition from the D3_{hot} to D0 state.

All PCI registers, ExCA registers, and CardBus registers are reset as a result of a D3_{hot}-to-D0 state transition, with the exception of the $\overline{\text{PME}}$ context bits (if $\overline{\text{PME}}$ is enabled) and the $\overline{\text{GRST}}$ only bits. See Table 4–23 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Power management control/status															
Type	RC	R	R	R	R	R	R	R/W	R	R	R	R	R	R	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Power management control/status**
 Type: Read-only, Read/Write, Read/Clear
 Offset: A4h (Functions 0, 1)
 Default: 0000h

Table 4–23. Power Management Control/Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
15	PMESTAT	RC	$\overline{\text{PME}}$ status. Bit 15 is set when the CardBus function would normally assert $\overline{\text{PME}}$, independent of the state of bit 8 ($\overline{\text{PME_EN}}$). Bit 15 is cleared by a write back of 1, and this also clears $\overline{\text{PME}}$ if $\overline{\text{PME}}$ was asserted by this function. Writing a 0 to this bit has no effect.
14–13	DATASCALE	R	Data scale. This 2-bit field returns 0s when read. The CardBus function does not return any dynamic data, as indicated by bit 4 ($\overline{\text{DYN_DATA_PME_EN}}$).
12–9	DATASEL	R	Data select. This 4-bit field returns 0s when read. The CardBus function does not return any dynamic data, as indicated by bit 4 ($\overline{\text{DYN_DATA_PME_EN}}$).
8	$\overline{\text{PME_EN}}$	R/W	$\overline{\text{PME}}$ enable. Bit 8 enables the function to assert $\overline{\text{PME}}$. If this bit is cleared, the assertion of $\overline{\text{PME}}$ is disabled.
7–5	RSVD	R	Reserved. Bits 7–5 return 0s when read.
4	$\overline{\text{DYN_DATA_PME_EN}}$	R	Dynamic data $\overline{\text{PME}}$ enable. Bit 4 returns 0 when read since the CardBus function does not report dynamic data.
3–2	RSVD	R	Reserved. Bits 3 and 2 return 0s when read.
1–0	PWRSTATE	R/W	Power state. This 2-bit field is used both to determine the current power state of a function and to set the function into a new power state. This field is encoded as: 00 = D0 01 = D1 10 = D2 11 = D3 _{hot}

4.47 Power Management Control/Status Bridge Support Extensions Register

The power management control/status bridge support extensions register supports PCI bridge-specific functionality. It is required for all PCI-to-PCI bridges. See Table 4–24 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	Power management control/status bridge support extensions							
Type	R	R	R	R	R	R	R	R
Default	1	1	0	0	0	0	0	0

Register: **Power management control/status bridge support extensions**
 Type: Read-only
 Offset: A6h (Functions 0, 1)
 Default: C0h

Table 4–24. Power Management Control/Status Bridge Support Extensions Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	BPCC_EN	R	<p>Bus power/clock control enable. This bit returns 1 when read. This bit is encoded as: 0 = Bus power/clock control is disabled. 1 = Bus power/clock control is enabled (default).</p> <p>A 0 indicates that the bus power/clock control policies defined in the <i>PCI Bus Power Management Interface Specification</i> are disabled. When the bus power/clock control enable mechanism is disabled, bits 1–0 of the bridge's power management control/status register power state field (PCI offset A4h, see Section 4.46) cannot be used by the system software to control the power or the clock of the bridge's secondary bus. A 1 indicates that the bus power/clock control mechanism is enabled.</p>
6	B2_B3	R	<p>B2/B3 support for D3_{hot}. The state of this bit determines the action that is to occur as a direct result of programming the function to D3_{hot}. This bit is meaningful only if bit 7 (BPCC_EN) is a 1. This bit is encoded as: 0 = When the bridge is programmed to D3_{hot}, its secondary bus will have its power removed (B3). 1 = When the bridge function is programmed to D3_{hot}, its secondary bus PCI clock is stopped (B2). (Default)</p>
5–0	RSVD	R	Reserved. Bits 5–0 return 0s when read.

4.48 General-Purpose Event Control/Status Register

If the $\overline{\text{GPE}}$ (general-purpose event) function is programmed onto the MFUNC5 terminal by writing 101b to bits 22–20 of the multifunction routing status register (PCI offset 8Ch, see Section 4.36), this register is used to program which events cause $\overline{\text{GPE}}$ to be asserted and to report the status. See Table 4–25 for the complete description of the register contents.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	$\overline{\text{GPE}}$ control/status															
Type	R	R	R	R	R	RC	RC	RC	R	R	R	R	R	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **General-purpose event control/status**

Type: Read-only, Read/Write, Read/Clear

Offset: A8h

Default: 0001h

Table 4–25. $\overline{\text{GPE}}$ Control/Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
15–11	RSVD	R	Reserved. Bits 15–11 return 0s when read.
10	ZV1_STS	RC	PC Card socket 1 status. Bit 10 is set on a change in status of bit 6 (ZVENABLE) in the card control register (PCI offset 91h, see Section 4.38) in function 1.
9	ZV0_STS	RC	PC Card socket 0 status. Bit 9 is set on a change in status of bit 6 (ZVENABLE) in the card control register (PCI offset 91h, see Section 4.38) in function 0.
8	VPP12_STS	RC	12-V Vpp request status. Bit 8 is set when software has changed the requested Vpp level to or from 12 volts from either socket.
7–3	RSVD	R	Reserved. Bits 7–3 return 0s when read.
2	ZV1_EN	R/W	PC Card socket 1 ZV event enable. When bit 2 is set, $\overline{\text{GPE}}$ is signaled on a change in status of the ZVENABLE bit in function 1 of the PC Card controller.
1	ZV0_EN	R/W	PC Card socket 0 ZV event enable. When bit 1 is set, $\overline{\text{GPE}}$ is signaled on a change in status of the ZVENABLE bit in function 0 of the PC Card controller.
0	VPP12_EN	R/W	12-V Vpp request event enable. When bit 0 is set, a $\overline{\text{GPE}}$ is signaled when software has changed the requested Vpp level to or from 12 V for either socket.

5 ExCA Compatibility Registers (Functions 0 and 1)

The ExCA (exchangeable card architecture) registers implemented in the PCI1451A device are register-compatible with the Intel 82365SL-DF PCMCIA controller. ExCA registers are identified by an offset value, which is compatible with the legacy I/O index/data scheme used on the Intel 82365 ISA controller. The ExCA registers are accessed through this scheme by writing the register offset value into the index register (I/O base), and reading or writing the data register (I/O base + 1). The I/O base address used in the index/data scheme is programmed in the PC Card 16-bit I/F legacy mode base address register (PCI offset 44h, see Section 4.28), which is shared by both card sockets. The offsets from this base address run contiguously from 00h to 3Fh for socket A, and from 40h to 7Fh for socket B. See Figure 5–1 for an ExCA I/O mapping illustration. Table 5–1 identifies each ExCA register and its respective ExCA offset.

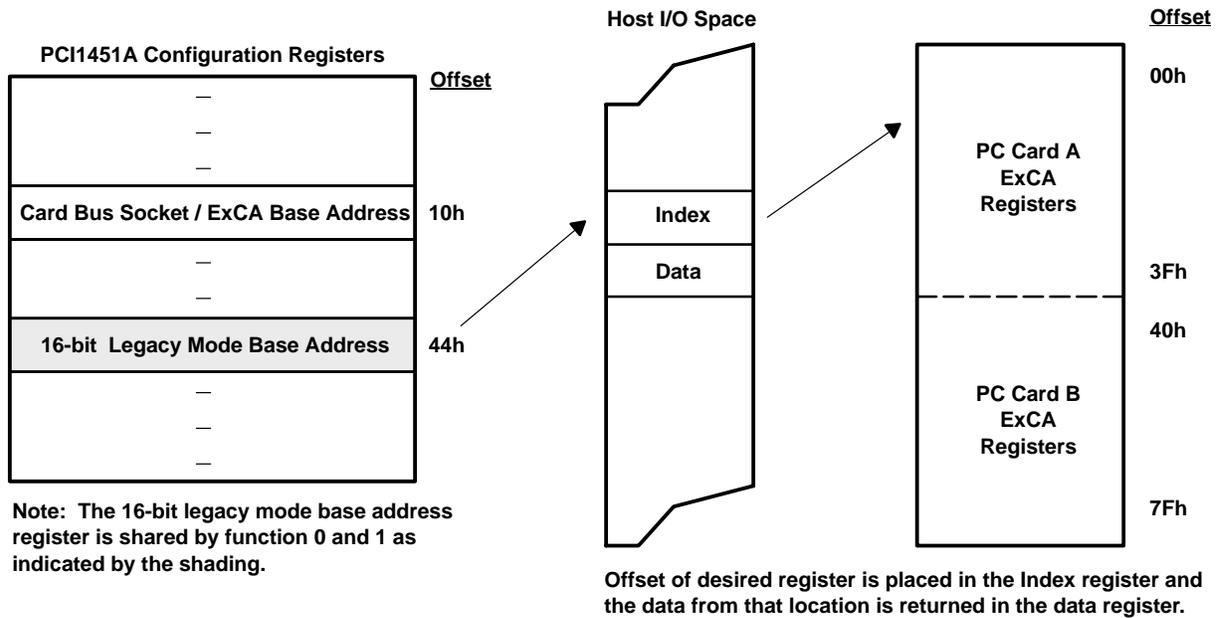


Figure 5–1. ExCA Register Access Through I/O

The TI™ PCI1451A device also provides a memory-mapped alias of the ExCA registers by directly mapping them into PCI memory space. They are located through the CardBus socket/ExCA base address register (PCI register 10h, see Section 4.12) at memory offset 800h. Each socket has a separate base address programmable by function. See Figure 5–2 for an ExCA memory-mapping illustration. Note that memory offsets are 800h–844h for both functions 0 and 1. This illustration also identifies the CardBus socket register mapping, which is mapped into the same 4K window at memory offset 0h.

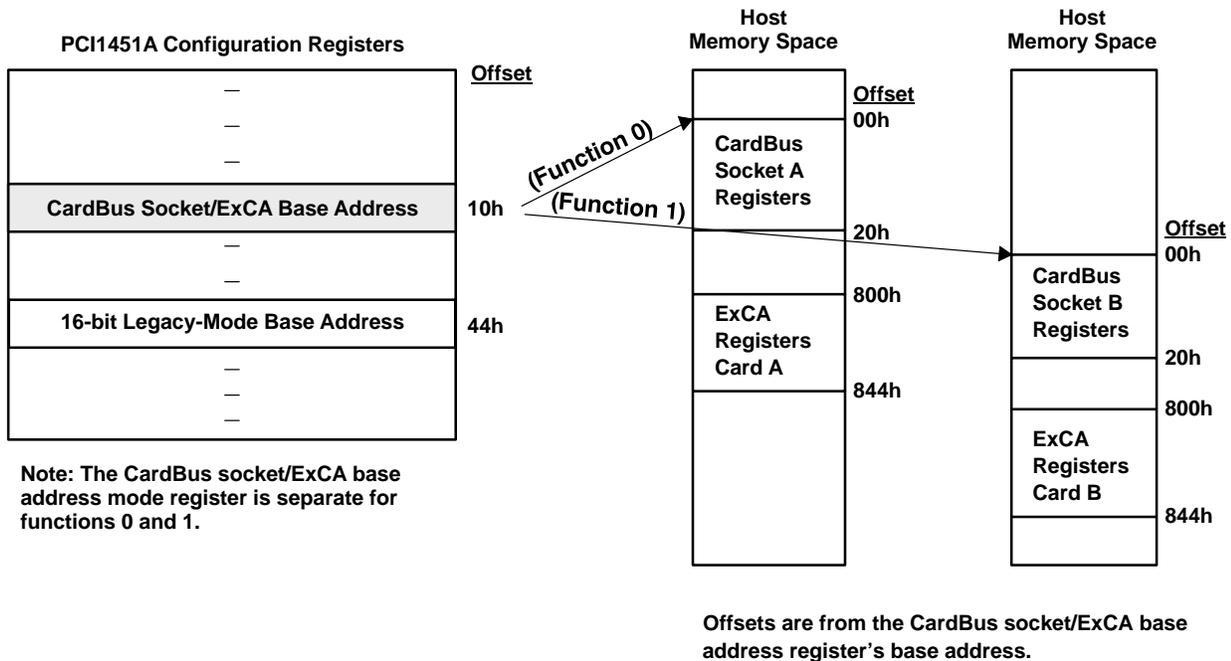


Figure 5–2. ExCA Register Access Through Memory

The interrupt registers in the ExCA register set control such card functions as reset, type, interrupt routing, and interrupt enables. Special attention must be paid to the interrupt routing registers and the host interrupt signaling method selected for the PCI1451A device to ensure that all possible PCI1451A interrupts potentially can be routed to the programmable interrupt controller. The ExCA registers that are critical to the interrupt signaling are the ExCA interrupt and general control register (ExCA offset 03h, see Section 5.4) and the ExCA card status-change-interrupt configuration register (ExCA offset 05h, see Section 5.6).

Access to I/O-mapped 16-bit PC Cards is available to the host system via two ExCA I/O windows. These are regions of host I/O address space into which the card I/O space is mapped. These windows are defined by start, end, and offset addresses programmed in the ExCA registers described in this section. I/O windows have byte granularity.

Access to memory-mapped 16-bit PC Cards is available to the host system via five ExCA memory windows. These are regions of host memory space into which the card memory space is mapped. These windows are defined by start, end, and offset addresses programmed in the ExCA registers described in this section. Memory windows have 4K byte granularity.

Table 5–1. ExCA Registers and Offsets

REGISTER NAME	PCI MEMORY ADDRESS OFFSET	EXCA OFFSET (CARD A)	EXCA OFFSET (CARD B)
Identification and revision	800	00	40
Interface status	801	01	41
Power control	802	02	42
Interrupt and general control	803	03	43
Card status change	804	04	44
Card status change interrupt configuration	805	05	45
Address window enable	806	06	46
I / O window control	807	07	47
I / O window 0 start-address low-byte	808	08	48
I / O window 0 start-address high-byte	809	09	49
I / O window 0 end-address low-byte	80A	0A	4A
I / O window 0 end-address high-byte	80B	0B	4B
I / O window 1 start-address low-byte	80C	0C	4C
I / O window 1 start-address high-byte	80D	0D	4D
I / O window 1 end-address low-byte	80E	0E	4E
I / O window 1 end-address high-byte	80F	0F	4F
Memory window 0 start-address low-byte	810	10	50
Memory window 0 start-address high-byte	811	11	51
Memory window 0 end-address low-byte	812	12	52
Memory window 0 end-address high-byte	813	13	53
Memory window 0 offset-address low-byte	814	14	54
Memory window 0 offset-address high-byte	815	15	55
Card detect and general control	816	16	56
Reserved	817	17	57
Memory window 1 start-address low-byte	818	18	58
Memory window 1 start-address high-byte	819	19	59
Memory window 1 end-address low-byte	81A	1A	5A
Memory window 1 end-address high-byte	81B	1B	5B
Memory window 1 offset-address low-byte	81C	1C	5C
Memory window 1 offset-address high-byte	81D	1D	5D
Global control	81E	1E	5E
Reserved	81F	1F	5F
Memory window 2 start-address low-byte	820	20	60
Memory window 2 start-address high-byte	821	21	61
Memory window 2 end-address low-byte	822	22	62
Memory window 2 end-address high-byte	823	23	63
Memory window 2 offset-address low-byte	824	24	64
Memory window 2 offset-address high-byte	825	25	65
Reserved	826	26	66
Reserved	827	27	67
Memory window 3 start-address low-byte	828	28	68
Memory window 3 start-address high-byte	829	29	69
Memory window 3 end-address low-byte	82A	2A	6A

Table 5–1. ExCA Registers and Offsets (Continued)

REGISTER NAME	PCI MEMORY ADDRESS OFFSET	EXCA OFFSET (CARD A)	EXCA OFFSET (CARD B)
Memory window 3 end-address high-byte	82B	2B	6B
Memory window 3 offset-address low-byte	82C	2C	6C
Memory window 3 offset-address high-byte	82D	2D	6D
Reserved	82E	2E	6E
Reserved	82F	2F	6F
Memory window 4 start-address low-byte	830	30	70
Memory window 4 start-address high-byte	831	31	71
Memory window 4 end-address low-byte	832	32	72
Memory window 4 end-address high-byte	833	33	73
Memory window 4 offset-address low-byte	834	34	74
Memory window 4 offset-address high-byte	835	35	75
I/O window 0 offset-address low-byte	836	36	76
I/O window 0 offset-address high-byte	837	37	77
I/O window 1 offset-address low-byte	838	38	78
I/O window 1 offset-address high-byte	839	39	79
Reserved	83A	3A	7A
Reserved	83B	3B	7B
Reserved	83C	3C	7C
Reserved	83D	3D	7D
Reserved	83E	3E	7E
Reserved	83F	3F	7F
Memory window page register 0	840	-	-
Memory window page register 1	841	-	-
Memory window page register 2	842	-	-
Memory window page register 3	843	-	-
Memory window page register 4	844	-	-

5.1 ExCA Identification and Revision Register

The ExCA identification and revision register provides host software with information on 16-bit PC Card support and Intel 82365SL-DF compatibility. This register is read-only or read/write, depending on the setting of bit 5 (SUBSYSRW) in the system control register (PCI offset 80h, see Section 4.29). See Table 5–2 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	ExCA identification and revision							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	1	0	0	0	0	1	0	0

Register: **ExCA identification and revision**

Type: Read/Write

Offset: CardBus Socket Address + 800h: Card A ExCA Offset 00h
 Card B ExCA Offset 40h

Default: 84h

Table 5–2. ExCA Identification and Revision Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–6	IFTYPE	R/W	Interface type. These bits, which are hardwired as 10b, identify the 16-bit PC Card support provided by the PCI1451A device. The PCI1451A device supports both I/O and memory 16-bit PC Cards.
5–4	RSVD	R/W	These bits can be used for Intel 82365SL emulation.
3–0	365REV	R/W	Intel 82365SL revision. This field stores the Intel 82365SL revision supported by the PCI1451A device. Host software can read this field to determine compatibility to the Intel 82365SL register set. This field defaults to 0100b upon PCI1451A reset.

5.2 ExCA Interface Status Register

The ExCA interface status register provides information on current status of the PC Card interface. An x in the default bit values indicates that the value of the bit after reset depends on the state of the PC Card interface. See Table 5–3 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	ExCA interface status							
Type	R	R	R	R	R	R	R	R
Default	0	0	x	x	x	x	x	x

Register: **ExCA interface status**

Type: Read-only

Offset: CardBus Socket Address + 801h: Card A ExCA Offset 01h
 Card B ExCA Offset 41h

Default: 00XX XXXXb

Table 5–3. ExCA Interface Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
7	RSVD	R	This bit returns 0 when read.
6	CARDPWR	R	Card power. This bit indicates the current power status of the PC Card socket. This bit reflects how the ExCA power control register (ExCA offset 02h, see Section 5.3) is programmed. The bit is encoded as: 0 = V_{CC} and V_{pp} to the socket are turned off (default). 1 = V_{CC} and V_{pp} to the socket are turned on.
5	READY	R	This bit indicates the current status of the READY signal at the PC Card interface. 0 = PC Card is not ready for a data transfer. 1 = PC Card is ready for a data transfer.
4	CARDWP	R	Card write protect. This bit indicates the current status of WP at the PC Card interface. This signal reports to the PCI1451A device whether or not the memory card is write protected. Furthermore, write protection for an entire PCI1451A 16-bit memory window is available by setting the appropriate bit in the ExCA memory window offset-address high-byte register (see Section 5.18). 0 = WP signal is 0. PC Card is R/W. 1 = WP signal is 1. PC Card is read-only.
3	CDETECT2	R	Card detect 2. This bit indicates the status of the $\overline{CD2}$ signal at the PC Card interface. Software may use this and bit 2 (CDETECT1) to determine if a PC Card is fully seated in the socket. 0 = $\overline{CD2}$ signal is 1. No PC Card is inserted. 1 = $\overline{CD2}$ signal is 0. PC Card is at least partially inserted.
2	CDETECT1	R	Card detect 1. This bit indicates the status of the $\overline{CD1}$ signal at the PC Card interface. Software may use this and bit 3 (CDETECT2) to determine if a PC Card is fully seated in the socket. 0 = $\overline{CD1}$ signal is 1. No PC Card is inserted. 1 = $\overline{CD1}$ signal is 0. PC Card is at least partially inserted.
1–0	BVDSTAT	R	Battery voltage detect. When a 16-bit memory card is inserted, the field indicates the status of the battery voltage detect signals (BVD1, BVD2) at the PC Card interface, where bit 0 reflects the BVD1 status and bit 1 reflects the BVD2 status. 00 = Battery is dead. 01 = Battery is dead. 10 = Battery is low; warning. 11 = Battery is good. When a 16-bit I/O card is inserted, this field indicates the status of \overline{SPKR} (bit 1) and \overline{STSCHG} (bit 0) at the PC Card interface. In this case, the two bits in this field directly reflect the current state of these card outputs.

5.5 ExCA Card Status-Change Register

The ExCA card status-change register reflects the status of PC Card CSC interrupt sources. The ExCA card status change interrupt configuration register (see Section 5.6) enables these interrupt sources to generate an interrupt to the host. When the interrupt source is disabled, the corresponding bit in this register always reads as 0. When an interrupt source is enabled and that particular event occurs, the corresponding bit in this register is set to indicate the interrupt source is active. After generating the interrupt to the host, the interrupt service routine must read this register to determine the source of the interrupt. The interrupt service routine is responsible for clearing the bits in this register as well. Clearing a bit is accomplished by one of two methods: a read of this register or an explicit writeback of 1 to the status bit. The choice of these two methods is based on the interrupt flag clear mode select, bit 2, in the ExCA global control register (see Section 5.22). See Table 5–6 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	ExCA card status-change							
Type	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0

Register: **ExCA card status-change**

Type: Read-only

Offset: CardBus Socket Address + 804h: Card A ExCA Offset 04h
Card B ExCA Offset 44h

Default: 00h

Table 5–6. ExCA Card Status-Change Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–4	RSVD	R	These bits return 0s when read.
3	CDCHANGE	R	Card detect change. This bit indicates whether a change on $\overline{CD1}$ or $\overline{CD2}$ occurred at the PC Card interface. A read of this bit or writing a 1 to this bit clears it. This bit is encoded as: 0 = No change is detected on either $\overline{CD1}$ or $\overline{CD2}$. 1 = A change is detected on either $\overline{CD1}$ or $\overline{CD2}$.
2	READYCHANGE	R	Ready change. When a 16-bit memory is installed in the socket, this bit includes whether the source of a PCI1451A interrupt was due to a change on READY at the PC Card interface, indicating that PC Card is now ready to accept new data. A read of this bit or writing a 1 to this bit clears it. This bit is encoded as: 0 = No low-to-high transition is detected on READY (default). 1 = Detected a low-to-high transition on READY. When a 16-bit I/O card is installed, this bit is always 0.
1	BATWARN	R	Battery warning change. When a 16-bit memory card is installed in the socket, this bit indicates whether the source of a PCI1451A interrupt was due to a battery-low warning condition. A read of this bit or writing a 1 to this bit clears it. This bit is encoded as: 0 = No battery warning condition (default) 1 = Detected a battery warning condition When a 16-bit I/O card is installed, this bit is always 0.
0	BATDEAD	R	Battery dead or status change. When a 16-bit memory card is installed in the socket, this bit indicates whether the source of a PCI1451A interrupt was due to a battery dead condition. A read of this bit or writing a 1 to this bit clears it. This bit is encoded as: 0 = STSCHG is deasserted (default). 1 = STSCHG is asserted. Ring indicate. When the PCI1451A device is configured for ring-indicate operation, this bit indicates the status of the \overline{RI} terminal.

5.11 ExCA I/O Windows 0 and 1 End-Address Low-Byte Registers

The ExCA I/O window 0 and 1 end-address low-byte registers contain the low byte of the 16-bit I/O window end address for I/O windows 0 and 1. The 8 bits of these registers correspond to the lower 8 bits of the start address.

Bit	7	6	5	4	3	2	1	0
Name	ExCA I/O windows 0 and 1 end-address low-byte							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **ExCA I/O window 0 end-address low-byte**

Offset: CardBus Socket Address + 80Ah: Card A ExCA Offset 0Ah
 Card B ExCA Offset 4Ah

Register: **ExCA I/O window 1 end-address low-byte**

Offset: CardBus Socket Address + 80Eh: Card A ExCA Offset 0Eh
 Card B ExCA Offset 4Eh

Type: Read/Write

Default: 00h

5.12 ExCA I/O Windows 0 and 1 End-Address High-Byte Registers

The ExCA I/O window 0 and 1 end-address high-byte registers contain the high byte of the 16-bit I/O window end address for I/O windows 0 and 1. The 8 bits of these registers correspond to the upper 8 bits of the end address.

Bit	7	6	5	4	3	2	1	0
Name	ExCA I/O windows 0 and 1 end-address high-byte							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **ExCA I/O window 0 end-address high-byte**

Offset: CardBus Socket Address + 80Bh: Card A ExCA Offset 0Bh
 Card B ExCA Offset 4Bh

Register: **ExCA I/O window 1 end-address high-byte**

Offset: CardBus Socket Address + 80Fh: Card A ExCA Offset 0Fh
 Card B ExCA Offset 4Fh

Type: Read/Write

Default: 00h

5.18 ExCA Memory Windows 0–4 Offset-Address High-Byte Registers

The ExCA memory window 0–4 offset-address high-byte registers contain the high 6 bits of the 16-bit memory window offset address for memory windows 0, 1, 2, 3, and 4. The lower 6 bits of these registers correspond to bits A25–A20 of the offset address. In addition, the write protection and common/attribute memory configurations are set in this register. See Table 5–12 for the complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	ExCA memory windows 0–4 offset-address high-byte							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **ExCA memory window 0 offset-address high-byte**

Offset: CardBus Socket Address + 815h: Card A ExCA Offset 15h
Card B ExCA Offset 55h

Register: **ExCA memory window 1 offset-address high-byte**

Offset: CardBus Socket Address + 81Dh: Card A ExCA Offset 1Dh
Card B ExCA Offset 5Dh

Register: **ExCA memory window 2 offset-address high-byte**

Offset: CardBus Socket Address + 825h: Card A ExCA Offset 25h
Card B ExCA Offset 65h

Register: **ExCA memory window 3 offset-address high-byte**

Offset: CardBus Socket Address + 82Dh: Card A ExCA Offset 2Dh
Card B ExCA Offset 6Dh

Register: **ExCA memory window 4 offset-address high-byte**

Offset: CardBus Socket Address + 835h: Card A ExCA Offset 35h
Card B ExCA Offset 75h

Type: Read/Write

Default: 00h

Table 5–12. ExCA Memory Windows 0–4 Offset-Address High-Byte Registers Description

BIT	SIGNAL	TYPE	FUNCTION
7	WINWP	R/W	Write protect. This bit specifies whether write operations to this memory window are enabled. This bit is encoded as: 0 = Write operations are allowed (default). 1 = Write operations are not allowed.
6	REG	R/W	This bit specifies whether this memory window is mapped to card attribute or common memory. This bit is encoded as: 0 = Memory window is mapped to common memory (default). 1 = Memory window is mapped to attribute memory.
5–0	OFFHB	R/W	Offset-address high byte. These bits represent the upper address bits A25–A20 of the memory window offset address.

5.23 ExCA Memory Windows 0–4 Page Registers

The upper 8 bits of a 4-byte PCI memory address are compared to the contents of this register when decoding addresses for 16-bit memory windows. Each window has its own page register, all of which default to 00h. By programming this register to a nonzero value, host software may locate 16-bit memory windows in any 1 of 256 16M-byte regions in the 4-Gigabyte PCI address space. These registers are accessible only when the ExCA registers are memory-mapped, that is, these registers may not be accessed using the index/data I/O scheme.

Bit	7	6	5	4	3	2	1	0
Name	ExCA memory windows 0–4 page							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **ExCA memory windows 0–4 page**
 Type: Read/Write
 Offset: CardBus Socket Address + 840h, 841h, 842h, 843h, 844h
 Default: 00h

6 CardBus Socket Registers (Functions 0 and 1)

The *PC Card Standard* requires a CardBus socket controller to provide five 32-bit registers which report and control the socket-specific functions. The PCI1451A device provides the CardBus socket/ExCA base address register (PCI offset 10h) to locate these CardBus socket registers in PCI memory address space. Each socket has a separate base address register for accessing the CardBus socket registers, see Figure 6–1. Table 6–1 lists the location of the socket registers in relation to the CardBus socket/ExCA base address.

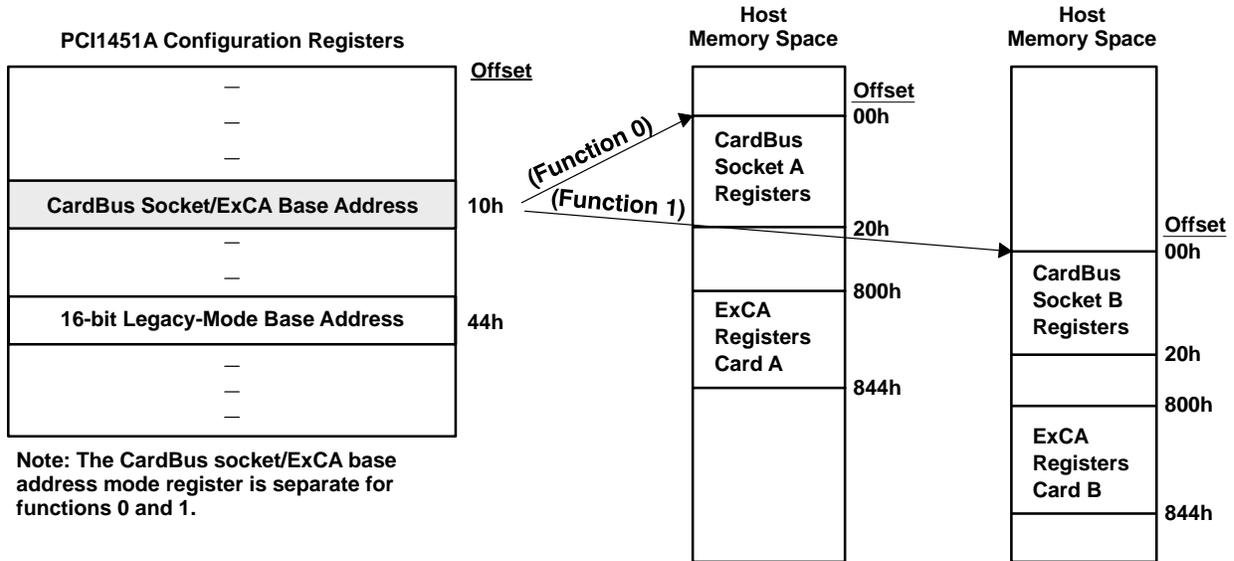


Figure 6–1. Accessing CardBus Socket Registers Through PCI Memory

Table 6–1. CardBus Socket Registers

REGISTER NAME	OFFSET
Socket event	00h
Socket mask	04h
Socket present state	08h
Socket force event	0Ch
Socket control	10h
Reserved	14h
Reserved	18h
Reserved	1Ch
Socket power management	20h

6.1 Socket Event Register

The socket event register indicates a change in socket status has occurred. These bits do not indicate what the change is, only that one has occurred. Software must read the socket present state register (CardBus offset 08h, see Section 6.3) for current status. Each bit in this register can be cleared by writing a 1 to that bit. The bits in this register can be set to a 1 by software through writing a 1 to the corresponding bit in the socket force event register (CardBus offset 0Ch, see Section 6.4). All bits in this register are cleared by PCI reset. They may be set again immediately if, when coming out of PC Card reset, the bridge finds the status unchanged (that is, CSTSCHG reasserted or card detect is still true). Software must clear this register before enabling interrupts. If it is not cleared and interrupts are enabled, an interrupt is generated (but not masked) based on any bit that is set. See Table 6–2 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket event															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket event															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R/WC	R/WC	R/WC	R/WC
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Socket event**
 Type: Read-only, Read/Write/Clear
 Offset: CardBus Socket Address + 00h
 Default: 0000 0000h

Table 6–2. Socket Event Register Description

BIT	SIGNAL	TYPE	FUNCTION
31–4	RSVD	R	These bits return 0s when read.
3	PWREVENT	R/WC	Power cycle. Bit 3 is set when the PCI1451A device detects that bit 3 (PWRCYCLE) in the socket present state register (CardBus offset 08h, see Section 6.3) has changed. This bit is cleared by writing a 1.
2	CD2EVENT	R/WC	$\overline{\text{CCD2}}$. Bit 2 is set when the PCI1451A device detects that bit 2 (CDETECT2) in the socket present state register (CardBus offset 08h, see Section 6.3) has changed. This bit is cleared by writing a 1.
1	CD1EVENT	R/WC	$\overline{\text{CCD1}}$. Bit 1 is set when the PCI1451A device detects that bit 1 (CDETECT1) in the socket present state register (CardBus offset 08h, see Section 6.3) has changed. This bit is cleared by writing a 1.
0	CSTSEVENT CSTSCHG	R/WC	This bit is set when bit 0 (CARDSTS) in the socket present state register (CardBus offset 08h, see Section 6.3) has changed state. For CardBus cards, bit 0 is set on the rising edge of the CSTSCHG signal. For 16-bit PC Cards, this bit is set on both transitions of the CSTSCHG signal. This bit is cleared by writing a 1.

6.2 Socket Mask Register

The socket mask register allows software to control the CardBus card events which generate a status change interrupt. The state of these mask bits does not prevent the corresponding bits from reacting in the socket event register (CardBus offset 00h, see Section 6.1). See Table 6–3 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket mask															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket mask															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Socket mask**
 Type: Read-only, Read/Write
 Offset: CardBus Socket Address + 04h
 Default: 0000 0000h

Table 6–3. Socket Mask Register Description

BIT	SIGNAL	TYPE	FUNCTION
31–4	RSVD	R	These bits return 0s when read.
3	PWRMASK	R/W	Power cycle. This bit masks bit 3 (PWRCYCLE) in the socket present state register (CardBus offset 08h, see Section 6.3) from causing a status change interrupt. 0 = PWRCYCLE event does not cause a CSC interrupt (default). 1 = PWRCYCLE event causes a CSC interrupt.
2–1	CDMASK	R/W	Card detect mask. These bits mask bit 1 (CDETECT1) and bit 2 (CDETECT2) in the socket present state register (CardBus offset 08h, see Section 6.3) from causing a CSC interrupt. 00 = Insertion/removal does not cause CSC interrupt (default). 01 = Reserved (undefined) 10 = Reserved (undefined) 11 = Insertion/removal causes a CSC interrupt.
0	CSTSMASK	R/W	CSTSCHG mask. This bit masks bit 0 (CARDSTS) in the socket present state register (CardBus offset 08h, see Section 6.3) from causing a CSC interrupt. 0 = CARDSTS event does not cause CSC interrupt (default). 1 = CARDSTS event causes a CSC interrupt.

6.3 Socket Present State Register

The socket present state register reports information about the socket interface. Writes to the socket force event register (CardBus offset 0Ch, see Section 6.4) are reflected here, as well as general socket interface status. Information about PC Card V_{CC} support and card type is only updated at each insertion. Also note that the PCI1451A device uses $\overline{CCD1}$ and $\overline{CCD2}$ during card identification, and changes on these signals during this operation are not reflected in this register. See Table 6–4 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket present state															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket present state															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	X	0	0	0	X	X	X

Register: **Socket present state**
 Type: Read-only
 Offset: CardBus Socket Address + 08h
 Default: 3000 00XXh

Table 6–4. Socket Present State Register Description

BIT	SIGNAL	TYPE	FUNCTION
31	YVSOCKET	R	YV socket. This bit indicates whether or not the socket can supply $V_{CC} = Y.Y$ V to PC Cards. The PCI1451A device does not support Y.YV V_{CC} ; therefore, this bit is hardwired to 0.
30	XVSOCKET	R	XV socket. This bit indicates whether or not the socket can supply $V_{CC} = X.X$ V to PC Cards. The PCI1451A device does not support X.X V V_{CC} ; therefore, this bit is hardwired to 0.
29	3VSOCKET	R	3-V socket. This bit indicates whether or not the socket can supply $V_{CC} = 3.3$ Vdc to PC Cards. The PCI1451A device does support 3.3 V V_{CC} ; therefore, this bit always is set unless overridden by the socket force event register (CardBus offset 0Ch, see Section 6.4).
28	5VSOCKET	R	5-V socket. This bit indicates whether or not the socket can supply $V_{CC} = 5.0$ Vdc to PC Cards. The PCI1451A device does support 5.0 V V_{CC} ; therefore, this bit always is set unless overridden by the socket force event register (CardBus offset 0Ch, see Section 6.4).
27–14	RSVD	R	These bits return 0s when read.
13	YVCARD	R	YV card. This bit indicates whether or not the PC Card inserted in the socket supports $V_{CC} = Y.Y$ Vdc. This bit can be set by writing to bit 13 (FYVCARD) in the socket force event register (CardBus offset 0Ch, see Section 6.4).
12	XVCARD	R	XV card. This bit indicates whether or not the PC Card inserted in the socket supports $V_{CC} = X.X$ Vdc. This bit can be set by writing to bit 12 (FXVCARD) in the socket force event register (CardBus offset 0Ch, see Section 6.4).
11	3VCARD	R	3-V card. This bit indicates whether or not the PC Card inserted in the socket supports $V_{CC} = 3.3$ Vdc. This bit can be set by writing to bit 11 (F3VCARD) in the socket force event register (CardBus offset 0Ch, see Section 6.4).
10	5VCARD	R	5-V card. This bit indicates whether or not the PC Card inserted in the socket supports $V_{CC} = 5.0$ Vdc. This bit can be set by writing to bit 10 (F5VCARD) in the socket force event register (CardBus offset 0Ch, see Section 6.4).
9	BADVCCREQ	R	Bad V_{CC} request. This bit indicates that the host software has requested that the socket be powered at an invalid voltage. 0 = Normal operation (default) 1 = Invalid V_{CC} request by host software

Table 6–4. Socket Present State Register Description (Continued)

BIT	SIGNAL	TYPE	FUNCTION
8	DATA_LOST	R	Data lost. This bit indicates that a PC Card removal event may have caused lost data because the cycle did not terminate properly or because write data still resides in the PC11451A device. 0 = Normal operation (default) 1 = Potential data loss due to card removal
7	NOTACARD	R	Not a card. This bit indicates that an unrecognizable PC Card has been inserted in the socket. This bit is not updated until a valid PC Card is inserted into the socket. 0 = Normal operation (default) 1 = Unrecognizable PC Card is detected.
6	IREQCINT	R	$\overline{\text{READY}}(\overline{\text{IREQ}})/\overline{\text{CINT}}$. This bit indicates the current status of the $\overline{\text{READY}}(\overline{\text{IREQ}})/\overline{\text{CINT}}$ signal at the PC Card interface. 0 = $\overline{\text{READY}}(\overline{\text{IREQ}})/\overline{\text{CINT}}$ is low. 1 = $\overline{\text{READY}}(\overline{\text{IREQ}})/\overline{\text{CINT}}$ is high.
5	CBCARD	R	CardBus card detected. This bit indicates that a CardBus PC Card is inserted in the socket. This bit is not updated until another card interrogation sequence occurs (card insertion).
4	16BITCARD	R	16-bit card detected. This bit indicates that a 16-bit PC Card is inserted in the socket. This bit is not updated until another card interrogation sequence occurs (card insertion).
3	PWRCYCLE	R	Power cycle. This bit indicates the status of the card power request. This bit is encoded as: 0 = Socket is powered down (default). 1 = Socket is powered up.
2	CDETECT2	R	$\overline{\text{CCD2}}$. This bit reflects the current status of the $\overline{\text{CCD2}}$ signal at the PC Card interface. Changes to this signal during card interrogation are not reflected here. 0 = $\overline{\text{CCD2}}$ is low (PC Card may be present). 1 = $\overline{\text{CCD2}}$ is high (PC Card not present).
1	CDETECT1	R	$\overline{\text{CCD1}}$. This bit reflects the current status of the $\overline{\text{CCD1}}$ signal at the PC Card interface. Changes to this signal during card interrogation are not reflected here. 0 = $\overline{\text{CCD1}}$ is low (PC Card may be present). 1 = $\overline{\text{CCD1}}$ is high (PC Card not present).
0	CARDSTS CSTSCHG	R	This bit reflects the current status of the CSTSCHG signal at the PC Card interface. 0 = CSTSCHG is low. 1 = CSTSCHG is high.

6.4 Socket Force Event Register

The socket force event register is used to force changes to the socket event register (CardBus offset 00h, see Section 6.1) and the socket present state register (CardBus offset 08h, see Section 6.3). Bit 14 (CVSTEST) in this register must be written when forcing changes that require card interrogation. See Table 6–5 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket force event															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket force event															
Type	R	W	W	W	W	W	W	W	W	R	W	W	W	W	W	W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Socket force event**
 Type: Read-only, Write-only
 Offset: CardBus Socket Address + 0Ch
 Default: 0000 0000h

Table 6–5. Socket Force Event Register Description

BIT	SIGNAL	TYPE	FUNCTION
31–15	RSVD	R	These bits return 0s when read.
14	CVSTEST	W	Card VS test. When this bit is set, the PCI1451A device reinterrogates the PC Card, updates the socket present state register (CardBus offset 08h, see Section 6.3), and re-enables the socket power control.
13	FYVCARD	W	Force YV card. Writes to this bit cause bit 13 (YVCARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written. When set, this bit disables the socket power control.
12	FXVCARD	W	Force XV card. Writes to this bit cause bit 12 (XVCARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written. When set, this bit disables the socket power control.
11	F3VCARD	W	Force 3-V card. Writes to this bit cause bit 11 (3VCARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written. When set, this bit disables the socket power control.
10	F5VCARD	W	Force 5-V card. Writes to this bit cause bit 10 (5VCARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written. When set, this bit disables the socket power control.
9	FBADVCCREQ	W	Force BadVccReq. Changes to bit 9 (BADVCCREQ) in the socket present state register (CardBus offset 08h, see Section 6.3) can be made by writing this bit.
8	FDATALOST	W	Force data lost. Writes to this bit cause bit 8 (DATALOST) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written.
7	FNOTACARD	W	Force not a card. Writes to this bit cause bit 7 (NOTACARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written.
6	RSVD	R	This bit returns 0 when read.
5	FCBCARD	W	Force CardBus card. Writes to this bit cause bit 5 (CBCARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written.
4	F16BITCARD	W	Force 16-bit card. Writes to this bit cause bit 4 (16BITCARD) in the socket present state register (CardBus offset 08h, see Section 6.3) to be written.
3	FPWRCYCLE	W	Force power cycle. Writes to this bit cause bit 3 (PWREVENT) in the socket event register (CardBus offset 00h, see Section 6.1) to be written, and bit 3 (PWRCYCLE) in the socket present state register (CardBus offset 08h, see Section 6.3) is unaffected.
2	FCDETECT2	W	Force $\overline{\text{CCD2}}$. Writes to this bit cause bit 2 (CD2EVENT) in the socket event register (CardBus offset 00h, see Section 6.1) to be written, and bit 2 (CDETECT2) in the socket present state register (CardBus offset 08h, see Section 6.3) is unaffected.
1	FCDETECT1	W	Force $\overline{\text{CCD1}}$. Writes to this bit cause bit 1 (CD1EVENT) in the socket event register (CardBus offset 00h, see Section 6.1) to be written, and bit 1 (CDETECT1) in the socket present state register (CardBus offset 08h, see Section 6.3) is unaffected.
0	FCARDSTS	W	Force CSTSCHG. Writes to this bit cause bit 0 (CSTSEVENT) in the socket event register (CardBus offset 00h, see Section 6.1) to be written. Bit 0 (CARDSTS) in the socket present state register (CardBus offset 08h, see Section 6.3) is unaffected.

6.5 Socket Control Register

The socket control register provides control of the voltages applied to the socket V_{PP} and V_{CC} . The PCI1451A device ensures that the socket is powered up only at acceptable voltages when a CardBus card is inserted. See Table 6–6 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket control															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket control															
Type	R	R	R	R	R	R	R	R	R/W	R/W	R/W	R/W	R	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Socket control**
 Type: Read-only, Read/Write
 Offset: CardBus Socket Address + 10h
 Default: 0000 0000h

Table 6–6. Socket Control Register Description

BIT	SIGNAL	TYPE	FUNCTION
31–8	RSVD	R	These bits return 0s when read.
7	STOPCLK	R/W	<p>This bit controls how the CardBus clock run state machine decides when to stop the CardBus clock to the CardBus Card:</p> <p>0 = The PCI1451A clock run master will request to stop the clock to the CardBus Card under the following two conditions: The CardBus interface is idle for 8 clocks and There is a request from the PCI master to stop the PCI clock.</p> <p>1 = The PCI1451A clock run master will try to stop the clock to the CardBus card under the following condition: The CardBus interface is idle for 8 clocks.</p> <p>In summary, if this bit is set to 1, the CardBus controller will try to stop the clock to the CardBus card independent of the PCI clock run signal if the CardBus interface is sampled idle for 8 clocks.</p>
6–4	VCCCTRL	R/W	<p>V_{CC} control. These bits are used to request card V_{CC} changes.</p> <p>000 = Request power off (default) 001 = Reserved 010 = Request V_{CC} = 5.0 V 011 = Request V_{CC} = 3.3 V 100 = Request V_{CC} = X.X V 101 = Request V_{CC} = Y.Y V 110 = Reserved 111 = Reserved</p>
3	RSVD	R	This bit returns 0 when read.
2–0	VPPCTRL	R/W	<p>V_{PP} control. These bits are used to request card V_{PP} changes.</p> <p>000 = Request power off (default) 001 = Request V_{pp} = 12.0 V 010 = Request V_{pp} = 5.0 V 011 = Request V_{pp} = 3.3 V 100 = Request V_{pp} = X.X V 101 = Request V_{pp} = Y.Y V 110 = Reserved 111 = Reserved</p>

6.6 Socket Power Management Register

The socket power management register provides power management control over the socket through a mechanism for slowing or stopping the clock on the card interface when the card is idle. See Table 6–7 for the complete description of the register contents.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Name	Socket power management															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	Socket power management															
Type	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R/W
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Register: **Socket power management**
 Type: Read-only, Read/Write
 Offset: CardBus Socket Address + 20h
 Default: 0000 0000h

Table 6–7. Socket Power Management Register Description

BIT	SIGNAL	TYPE	FUNCTION
31–26	RSVD	R	These bits return 0s when read.
25	SKTACCES	R	Socket access status. This bit provides information on when a socket access has occurred. This bit is cleared by a read access. 0 = No PC Card access has occurred (default). 1 = PC Card has been accessed.
24	SKTMODE	R	Socket mode status. This bit provides clock mode information. 0 = Clock is operating normally. 1 = Clock frequency has changed.
23–17	RSVD	R	These bits return 0s when read.
16	CLKCTRLLEN	R/W	CardBus clock control enable. This bit, when set, enables clock control according to bit 0 (CLKCTRL). 0 = Clock control is disabled (default). 1 = Clock control is enabled.
15–1	RSVD	R	These bits return 0s when read.
0	CLKCTRL	R/W	CardBus clock control. This bit determines whether the CardBus $\overline{\text{CLKRUN}}$ protocol stops or slows the CardBus clock during idle states. Bit 16 (CLKCTRLLEN) enables this bit. 0 = Allows the CardBus $\overline{\text{CLKRUN}}$ protocol to stop the CardBus clock (default). 1 = Allows the CardBus $\overline{\text{CLKRUN}}$ protocol to slow the CardBus clock by a factor of 16.

7 Distributed DMA (DDMA) Registers

The DMA base address, programmable in PCI configuration space as bits 15–4 (DMABASE field) of socket DMA register 1 (PCI offset 98h, see Section 4.42), points to a 16-byte region in PCI I/O space where the DMA registers reside. Table 7–1 summarizes the names and locations of these registers. These registers are identical in function to, but different in location from, those of the Intel 8237 DMA controller. The similarity between the register models retains some level of compatibility with legacy DMA and simplifies the translation required by the master DMA device when forwarding legacy DMA writes to DMA channels.

These PCI1451A DMA register definitions are identical to those registers of the same name in the 8237 DMA controller; however, some register bits defined in the 8237 DMA controller do not apply to distributed DMA in a PCI environment. In such cases, the PCI1451A device implements these obsolete register bits as nonfunctional, read-only bits. The reserved registers shown in Table 7–1 are implemented as read-only and return 0s when read. Writes to reserved registers have no effect.

Table 7–1. Distributed DMA Registers

TYPE	REGISTER NAME				DMA BASE ADDRESS OFFSET
R	Reserved	Page	Current address		00h
W			Base address		
R	Reserved	Reserved	Current count		04h
W			Base count		
R	N/A	Reserved	N/A	Status	08h
W	Mode		Request	Command	
R	Multichannel	Reserved	N/A		0Ch
W	Mask		Master clear		

7.1 DMA Current Address/Base Address Register

This register is used to set the starting (base) memory address of a DMA transfer. Reads from this register indicate the current memory address of a direct memory transfer.

For the 8-bit DMA transfer mode, the DMA current address register contents are presented on AD15–0 of the PCI bus during the address phase. Bits 7–0 of the DMA page register are presented on AD23–AD16 of the PCI bus during the address phase.

For the 16-bit DMA transfer mode, the DMA current address register contents are presented on AD16–AD1 of the PCI bus during the address phase, and AD0 is driven to logic 0. Bits 7–1 of the DMA page register (see Section 7.2) are presented on AD23–AD17 of the PCI bus during the address phase, and bit 0 is ignored.

Bit	15	14	13	12	11	10	9	8
Name	DMA current address/base address							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0
Bit	7	6	5	4	3	2	1	0
Name	DMA current address/base address							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **DMA current address/base address**

Type: Read/Write

Offset: DMA Base Address + 00h

Default: 0000h

7.2 DMA Page Register

This register is used to set the upper byte of the address of a DMA transfer. Details of the address represented by this register are explained in Section 7.1, *DMA Current Address/Base Address Register*.

Bit	7	6	5	4	3	2	1	0
Name	DMA page							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **DMA page**

Type: Read/Write

Offset: DMA Base Address + 02h

Default: 00h

7.3 DMA Current Count/Base Count Register

This register is used to set the total transfer count, in bytes, of a direct memory transfer. Reads from this register indicate the current count of a direct memory transfer. In the 8-bit transfer mode, the count is decremented by 1 after each transfer. Likewise, the count is decremented by 2 in 16-bit transfer mode.

Bit	15	14	13	12	11	10	9	8
Name	DMA current count/base count							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0
Bit	7	6	5	4	3	2	1	0
Name	DMA current count/base count							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Default	0	0	0	0	0	0	0	0

Register: **DMA current count/base count**
 Type: Read/Write
 Offset: DMA Base Address + 04h
 Default: 0000h

7.4 DMA Command Register

This register is used to enable and disable the DMA controller. Bit 2 defaults to 0, enabling the DMA controller; all other bits are reserved. See Table 7–2 for a complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	DMA command							
Type	R	R	R	R	R	R/W	R	R
Default	0	0	0	0	0	0	0	0

Register: **DMA command**
 Type: Read-only, Read/Write
 Offset: DMA Base Address + 08h
 Default: 00h

Table 7–2. DMA Command Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–3	RSVD	R	These bits return 0s when read.
2	DMAEN	R/W	DMA controller enable. This bit enables and disables the distributed DMA slave controller in the PCI1451A device, and defaults to the enabled state. 0 = DMA controller is enabled (default). 1 = DMA controller is disabled.
1–0	RSVD	R	These bits return 0s when read.

7.5 DMA Status Register

This register indicates the terminal count and DMA request ($\overline{\text{DREQ}}$) status. See Table 7–3 for a complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	DMA status							
Type	R	R	R	R	R/C	R/C	R/C	R/C
Default	0	0	0	0	0	0	0	0

Register: **DMA status**
 Type: Read-only
 Offset: DMA Base Address + 08h
 Default: 00h

Table 7–3. DMA Status Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–4	DREQSTAT	R	Channel request. In the 8237, these bits indicate the status of the $\overline{\text{DREQ}}$ signal of each DMA channel. In the PCI1451A device, these bits indicate the $\overline{\text{DREQ}}$ status of the single socket being serviced by this register. All four bits are set when the PC Card asserts its $\overline{\text{DREQ}}$ signal, and are reset when $\overline{\text{DREQ}}$ is deasserted. The status of the mask bit in the DMA multichannel mask register (see Section 7.9) has no effect on these bits.
3–0	TC	R/C	Channel terminal count. The 8327 uses these bits to indicate the TC status of each of its four DMA channels. In the PCI1451A device, these bits report information about just a single DMA channel; therefore, all four of these register bits indicate the TC status of the single socket being serviced by this register. All four bits are set when the terminal count (TC) is reached by the DMA channel. These bits are reset when read or when the DMA channel is reset.

7.6 DMA Request Register

This register is used to request a DMA transfer through software. Any write to this register enables software requests. This register is to be used in block mode only.

Bit	7	6	5	4	3	2	1	0
Name	DMA request							
Type	W	W	W	W	W	W	W	W
Default	0	0	0	0	0	0	0	0

Register: **DMA request**
 Type: Write-only
 Offset: DMA Base Address + 09h
 Default: 00h

7.7 DMA Mode Register

This register is used to set the DMA transfer mode. See Table 7–4 for a complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	DMA mode							
Type	R/W	R/W	R/W	R/W	R/W	R/W	R	R
Default	0	0	0	0	0	0	0	0

Register: **DMA mode**
 Type: Read-only, Read/Write
 Offset: DMA Base Address + 0Bh
 Default: 00h

Table 7–4. DMA Mode Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–6	DMAMODE	R/W	Mode select bits. The PCI1451A device uses these bits to determine the transfer mode. 00 = Demand mode is selected (default). 01 = Single mode is selected. 10 = Block mode is selected. 11 = Reserved
5	INCDEC	R/W	Address increment/decrement. The PCI1451A device uses this register bit to select the memory address in the DMA current address/base address register (see Section 7.1) to increment or decrement after each data transfer. This is in accordance with the 8237 use of this register bit, and is encoded as follows: 0 = Addresses increment (default) 1 = Addresses decrement
4	AUTOINIT	R/W	Auto-initialization bit. 0 = Auto-initialization is disabled (default). 1 = Auto-initialization is enabled.
3–2	XFERTYPE	R/W	Transfer type. These bits select the type of direct memory transfer to be performed. A memory write transfer moves data from the PCI1451A PC Card interface to memory, and a memory read transfer moves data from memory to the PCI1451A PC Card interface. The field is encoded as: 00 = No transfer selected (default) 01 = Write transfer 10 = Read transfer 11 = Reserved
1–0	RSVD	R	These bits return 0s when read.

7.8 DMA Master Clear Register

This register is used to reset the DMA controller, and resets all DMA registers.

Bit	7	6	5	4	3	2	1	0
Name	DMA master clear							
Type	W	W	W	W	W	W	W	W
Default	0	0	0	0	0	0	0	0

Register: **DMA master clear**
 Type: Write-only
 Offset: DMA Base Address + 0Dh
 Default: 00h

7.9 DMA Multichannel/Mask Register

The PCI1451A device uses only the least significant bit of this register to mask the PC Card DMA channel. The PCI1451A device sets the mask bit when the PC Card is removed. Host software is responsible for either resetting the socket DMA controller or re-enabling the mask bit. See Table 7–5 for a complete description of the register contents.

Bit	7	6	5	4	3	2	1	0
Name	DMA multichannel/mask							
Type	R	R	R	R	R	R	R	R/W
Default	0	0	0	0	0	0	0	0

Register: **DMA multichannel/mask**
 Type: Read-only, Read/Write
 Offset: DMA Base Address + 0Fh
 Default: 00h

Table 7–5. DMA Multichannel/Mask Register Description

BIT	SIGNAL	TYPE	FUNCTION
7–1	RSVD	R	These bits return 0s when read.
0	MASKBIT	R/W	Mask select bit. This bit masks incoming $\overline{\text{DREQ}}$ signals from the PC Card. When set, the socket ignores DMA requests from the card. When cleared (or when reset to 0), incoming $\overline{\text{DREQ}}$ assertions are serviced normally. 0 = DMA service is provided on card $\overline{\text{DREQ}}$. 1 = Socket $\overline{\text{DREQ}}$ signal is ignored (default).

8 Electrical Characteristics

8.1 Absolute Maximum Ratings Over Operating Temperature Ranges†

Supply voltage range, V_{CC}	-0.5 V to 4.6 V
Supply voltage range, V_{CCP} , V_{CCA} , V_{CCB}	-0.5 V to 6 V
Input voltage range, V_I : PCI	-0.5 V to $V_{CCP} + 0.5$ V
Card A	-0.5 V to $V_{CCA} + 0.5$ V
Card B	-0.5 V to $V_{CCB} + 0.5$ V
Miscellaneous	-0.5 V to $V_{CC} + 0.5$ V
Output voltage range, V_O : PCI	-0.5 V to $V_{CC} + 0.5$ V
Card A	-0.5 V to $V_{CCA} + 0.5$ V
Card B	-0.5 V to $V_{CCB} + 0.5$ V
Miscellaneous	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1)	± 20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 2)	± 20 mA
Storage temperature range, T_{stg}	-65°C to 150°C
Virtual junction temperature, T_J	150°C

† Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. Applies for external input and bidirectional buffers. $V_I > V_{CC}$ does not apply to miscellaneous terminals. PCI terminals are measured with respect to V_{CCP} instead of V_{CC} . PC Card terminals are measured with respect to V_{CCA} or V_{CCB} . The limit specified applies for a dc condition.
2. Applies for external output and bidirectional buffers. $V_O > V_{CC}$ does not apply to miscellaneous terminals. PCI terminals are measured with respect to V_{CCP} instead of V_{CC} . PC Card terminals are measured with respect to V_{CCA} or V_{CCB} . The limit specified applies for a dc condition.

8.2 Recommended Operating Conditions (see Note 3)

			OPERATION	MIN	NOM	MAX	UNIT
V _{CC}	Core voltage	Commercial	3.3 V	3	3.3	3.6	V
V _{CCP}	PCI I/O voltage	Commercial	3.3 V	3	3.3	3.6	V
			5 V	4.75	5	5.25	
V _{CC(A/B)}	PC Card I/O voltage	Commercial	3.3 V	3	3.3	3.6	V
			5 V	4.75	5	5.25	
V _{IH} [†]	High-level Input voltage	PCI	3.3 V	0.5 V _{CCP}		V _{CCP}	V
			5 V	2		V _{CCP}	
		PC Card	3.3 V	0.475 V _{CC(A/B)}		V _{CC(A/B)}	
			5 V	2.4		V _{CC(A/B)}	
		VS	3.3 V	2		V _{CC}	
		CD	3.3 V	2.4		V _{CC}	
Miscellaneous [‡]		2		V _{CC}			
V _{IL} [†]	Low-level input voltage	PCI	3.3 V	0		0.3 V _{CCP}	V
			5 V	0		0.8	
		PC Card	3.3 V	0		0.325 V _{CC(A/B)}	
			5 V	0		0.8	
Miscellaneous [‡]		0		0.8			
V _I	Input voltage	PCI		0		V _{CCP}	V
		PC Card		0		V _{CC(A/B)}	
		Miscellaneous [‡]		0		V _{CC}	
V _O [¶]	Output voltage	PCI		0		V _{CCP}	V
		PC Card		0		V _{CC(A/B)}	
		Miscellaneous [‡]		0		V _{CC}	
t _t	Input transition times (t _r and t _f)	PCI and PC Card		1		4	ns
		Miscellaneous [‡]		0		6	
T _A	Operating ambient temperature range			0	25	70	°C
T _J [§]	Virtual junction temperature			0	25	115	°C

[†] Applies to external inputs and bidirectional buffers without hysteresis

[‡] Miscellaneous terminals are RI_OUT, CLOCK, DATA, LATCH, SPKROUT, SCL, SDA, SUSPEND, MFUNC terminals, VS terminals, CD terminals, and ZV terminals.

[§] These junction temperatures reflect simulation conditions. The customer is responsible for verifying junction temperature.

[¶] Applies to external output buffers

NOTE 3: Unused or floating terminals (input or I/O) must be held high or low.

8.3 Electrical Characteristics Over Recommended Operating Conditions (unless otherwise noted)

PARAMETER	TERMINALS	OPERATION	TEST CONDITIONS	MIN	MAX	UNIT
V _{OH} High-level output voltage	PCI	3.3 V	I _{OH} = -0.5 mA	0.9 V _{CC}		V
		5 V	I _{OH} = -2 mA	2.4		
	PC Card	3.3 V	I _{OH} = -0.15 mA	0.9 V _{CC}		
		5 V	I _{OH} = -0.15 mA	2.4		
Miscellaneous [§]		I _{OH} = -4 mA	V _{CC} -0.6			
V _{OL} Low-level output voltage	PCI	3.3 V	I _{OL} = 1.5 mA	0.1 V _{CC}		V
		5 V	I _{OL} = 6 mA	0.55		
	PC Card	3.3 V	I _{OL} = 0.7 mA	0.1 V _{CC}		
		5 V	I _{OL} = 0.7 mA	0.55		
Miscellaneous [§]		I _{OL} = 4 mA	0.5			
I _{OZL} 3-state-output, high-impedance-state current	Output-only terminals	3.6 V	V _I = GND		-1	μA
		5.25 V	V _I = GND		-1	
I _{OZH} 3-state-output, high-impedance-state current	Output-only terminals	3.6 V	V _I = V _{CC} [¶]		10	μA
		5.25 V	V _I = V _{CC} [¶]		25	
I _{IL} Low-level input current	Input-only terminals		V _I = GND		-1	μA
	I/O terminals [†]		V _I = GND		-10	
	Pullup terminals [‡]		V _I = GND		-190	
I _{IH} High-level input current	Input-only terminals	3.6 V	V _I = V _{CC} [¶]		10	μA
		5.25 V	V _I = V _{CC} [¶]		20	
	I/O terminals [†]	3.6 V	V _I = V _{CC} [¶]		10	
		5.25 V	V _I = V _{CC} [¶]		25	

[†] For I/O terminals, input leakage (I_{IL} and I_{IH}) includes I_{OZ} leakage of the disabled output.

[‡] Pullup terminals: A_CPERR, A_CIRDY, A_CBLOCK, A_CSTOP, A_CDEVSEL, A_CTRDY, A_CSTSCHG, A_CAUDIO, A_CCD1, A_CCD2, A_CREQ, A_CINT, A_CRST, A_CVS1, A_CVS2, A_CSERR, B_CPERR, B_CIRDY, B_CBLOCK, B_CSTOP, B_CDEVSEL, B_CTRDY, B_CSTSCHG, B_CAUDIO, B_CCD1, B_CCD2, B_CREQ, B_CINT, B_CRST, B_CVS1, B_CVS2, B_CSERR, MFUNC5, MFUNC6, and LATCH.

[§] Miscellaneous terminals are RI_OUT, CLOCK, DATA, LATCH, SPKROUT, SCL, SDA, SUSPEND, MFUNC terminals, VS terminals, CD terminals, and ZV terminals.

[¶] For PCI terminals, V_I = V_{CCP}. For PC Card terminals, V_I = V_{CC(A/B)}.

8.4 PCI Clock/Reset Timing Requirements Over Recommended Ranges of Supply Voltage and Operating Free-Air Temperature (see Figure 8-2 and Figure 8-3)

PARAMETER	ALTERNATE SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
t _c Cycle time, PCLK	t _{cyc}		30		ns
t _{wH} Pulse duration, PCLK high	t _{high}		11		ns
t _{wL} Pulse duration, PCLK low	t _{low}		11		ns
Δv/Δt Slew rate, PCLK	t _r , t _f		1	4	V/ns
t _w Pulse duration, RSTIN	t _{rst}		1		ms
t _{su} Setup time, PCLK active at end of RSTIN	t _{rst-clk}		100		μs

8.5 PCI Timing Requirements Over Recommended Ranges of Supply Voltage and Operating Free-Air Temperature (see Note 7, Figure 8–1 and Figure 8–4)

PARAMETER		ALTERNATE SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
t _{pd}	Propagation delay time, See Note 4	PCLK-to-shared signal valid delay time	C _L = 50 pF, See Note 5		11	ns
		PCLK-to-shared signal invalid delay time			2	
t _{en}	Enable time, high impedance-to-active delay time from PCLK	t _{on}		2		ns
t _{dis}	Disable time, active-to-high impedance delay time from PCLK	t _{off}			28	ns
t _{su}	Setup time before PCLK valid	t _{su}		7		ns
t _h	Hold time after PCLK high	t _h		0		ns

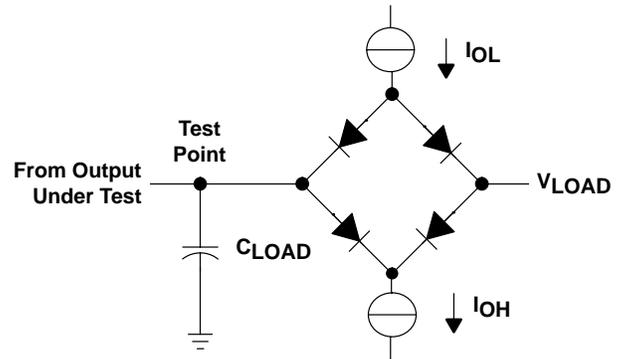
- NOTES: 4. PCI shared signals are AD31–AD0, C/BE3–C/BE0, FRAME, TRDY, IRDY, STOP, IDSEL, DEVSSEL, and PAR.
5. This data sheet uses the following conventions to describe time (t) intervals. The format is t_A, where subscript A indicates the type of dynamic parameter being represented. One of the following is used: t_{pd} = propagation delay time, t_d = delay time, t_{su} = setup time, and t_h = hold time.

8.6 Parameter Measurement Information

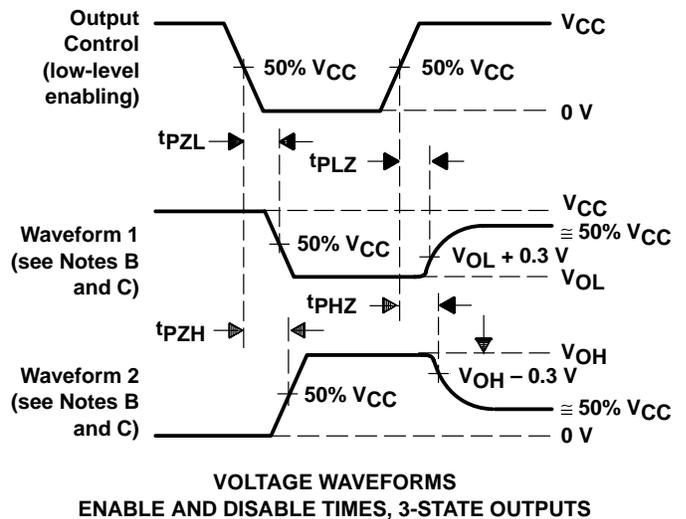
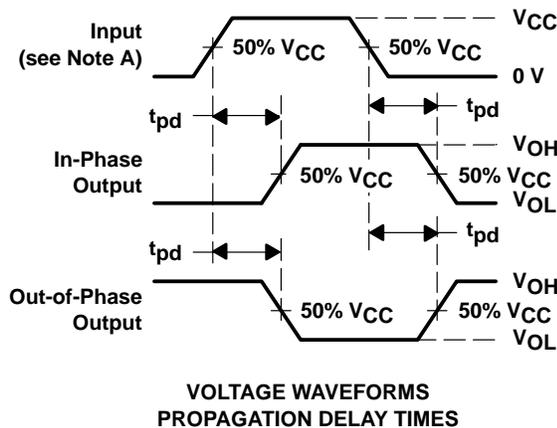
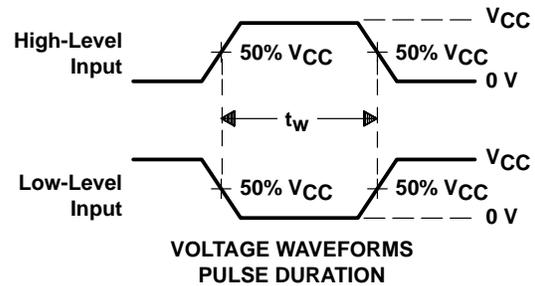
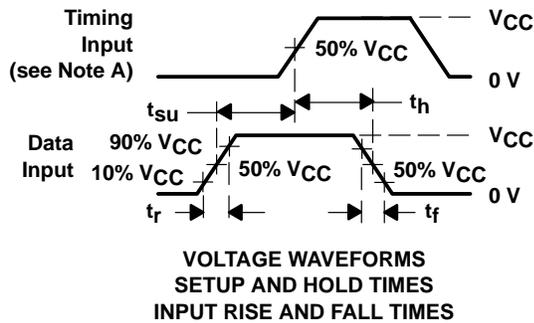
LOAD CIRCUIT PARAMETERS					
TIMING PARAMETER		C_{LOAD}^{\dagger} (pF)	I_{OL} (mA)	I_{OH} (mA)	V_{LOAD}^{\ddagger} (V)
t_{en}	tPZH	50	8	-8	0
	tPZL				3
t_{dis}	tPHZ	50	8	-8	1.5
	tPLZ				
t_{pd}		50	8	-8	‡

$\dagger C_{LOAD}$ includes the typical load-circuit distributed capacitance.

$\ddagger \frac{V_{LOAD} - V_{OL}}{I_{OL}} = 50 \Omega$, where $V_{OL} = 0.6 V$, $I_{OL} = 8 mA$



LOAD CIRCUIT



- NOTES: A. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by pulse generators having the following characteristics: PRR = 1 MHz, $Z_O = 50 \Omega$, $t_r = 6 ns$.
- B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
- C. For t_{PLZ} and t_{PHZ} , V_{OL} and V_{OH} are measured values.

Figure 8–1. Load Circuit and Voltage Waveforms

8.7 PCI Bus Parameter Measurement Information

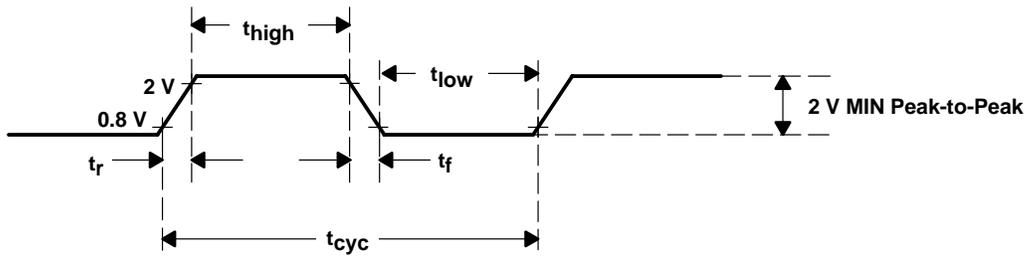


Figure 8-2. PCLK Timing Waveform

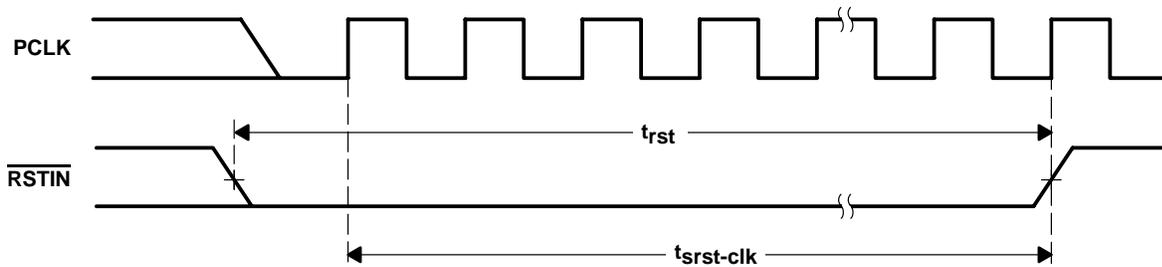


Figure 8-3. $\overline{\text{RSTIN}}$ Timing Waveforms

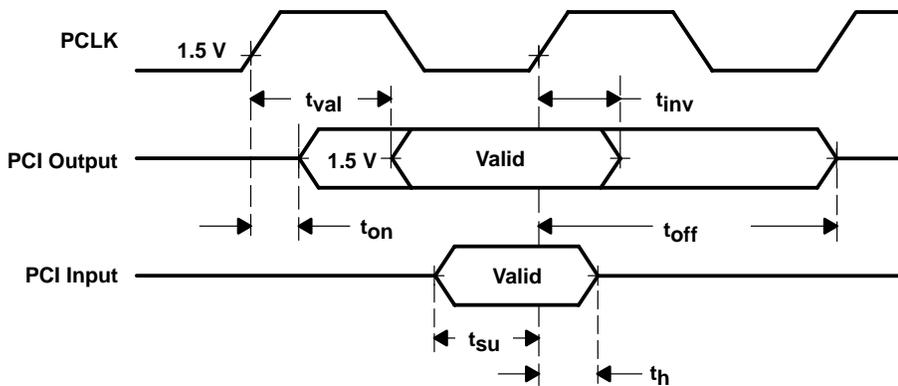


Figure 8-4. Shared Signals Timing Waveforms

8.8 PC Card Cycle Timing

The PC Card cycle timing is controlled by the wait-state bits in the Intel 82365SL-DF compatible memory and I/O window registers. The PC Card cycle generator uses the PCI clock to generate the correct card address setup and hold times and the PC Card command active (low) interval. This allows the cycle generator to output PC Card cycles that are as close to the Intel 82365SL-DF timing as possible, while always slightly exceeding the Intel 82365SL-DF values. This ensures compatibility with existing software and maximizes throughput.

The PC Card address setup and hold times are a function of the wait-state bits. Table 8-1 shows address setup time in PCLK cycles and nanoseconds for I/O and memory cycles. Table 8-2 and Table 8-3 show command active time in PCLK cycles and nanoseconds for I/O and memory cycles. Table 8-4 shows address hold time in PCLK cycles and nanoseconds for I/O and memory cycles.

Table 8–1. PC Card Address Setup Time, $t_{su(A)}$, 8-Bit and 16-Bit PCI Cycles

WAIT-STATE BITS			TS1 – 0 = 01 (PCLK/ns)
I/O			3/90
Memory	WS1	0	2/60
Memory	WS1	1	4/120

Table 8–2. PC Card Command Active Time, $t_{c(A)}$, 8-Bit PCI Cycles

WAIT-STATE BITS			TS1 – 0 = 01 (PCLK/ns)
	WS	ZWS	
	I/O	0	
	1	X	23/690
	0	1	7/210
Memory	00	0	19/570
	01	X	23/690
	10	X	23/690
	11	X	23/690
	00	1	7/210

Table 8–3. PC Card Command Active Time, $t_{c(A)}$, 16-Bit PCI Cycles

WAIT-STATE BITS			TS1 – 0 = 01 (PCLK/ns)
	WS	ZWS	
	I/O	0	
	1	X	11/330
	0	1	N/A
Memory	00	0	9/270
	01	X	13/390
	10	X	17/510
	11	X	23/630
	00	1	5/150

Table 8–4. PC Card Address Hold Time, $t_{h(A)}$, 8-Bit and 16-Bit PCI Cycles

WAIT-STATE BITS			TS1 – 0 = 01 (PCLK/ns)
I/O			2/60
Memory	WS1	0	2/60
Memory	WS1	1	3/90

8.9 Timing Requirements Over Recommended Ranges of Supply Voltage and Operating Free-Air Temperature, Memory Cycles (for 100-ns Common Memory)

(see Note 8 and Figure 8–5)

	ALTERNATE SYMBOL	MIN	MAX	UNIT
t_{su} Setup time, $\overline{CE1}$ and $\overline{CE2}$ before $\overline{WE}/\overline{OE}$ low	T1	60		ns
t_{su} Setup time, CA25–CA0 before $\overline{WE}/\overline{OE}$ low	T2	$t_{su(A)}+2PCLK$		ns
t_{su} Setup time, \overline{REG} before $\overline{WE}/\overline{OE}$ low	T3	90		ns
t_{pd} Propagation delay time, $\overline{WE}/\overline{OE}$ low to \overline{WAIT} low	T4			ns
t_w Pulse duration, $\overline{WE}/\overline{OE}$ low	T5	200		ns
t_h Hold time, $\overline{WE}/\overline{OE}$ low after \overline{WAIT} high	T6			ns
t_h Hold time, $\overline{CE1}$ and $\overline{CE2}$ after $\overline{WE}/\overline{OE}$ high	T7	120		ns
t_{su} Setup time (read), CDATA15–CDATA0 valid before \overline{OE} high	T8			ns
t_h Hold time (read), CDATA15–CDATA0 valid after \overline{OE} high	T9	0		ns
t_h Hold time, CA25–CA0 and \overline{REG} after $\overline{WE}/\overline{OE}$ high	T10	$t_{h(A)}+1PCLK$		ns
t_{su} Setup time (write), CDATA15–CDATA0 valid before \overline{WE} low	T11	60		ns
t_h Hold time (write), CDATA15–CDATA0 valid after \overline{WE} low	T12	240		ns

NOTE 6: These times are dependent on the register settings associated with ISA wait states and data size. They are also dependent on cycle type (read/write, memory/I/O) and \overline{WAIT} from PC Card. The times listed here represent absolute minimums (the times that would be observed if programmed for zero wait state, 16-bit cycles) with a 33-MHz PCI clock.

8.10 Timing Requirements Over Recommended Ranges of Supply Voltage and Operating Free-Air Temperature, I/O Cycles

(see Figure 8–6)

	ALTERNATE SYMBOL	MIN	MAX	UNIT
t_{su} Setup time, \overline{REG} before $\overline{IORD}/\overline{IOWR}$ low	T13	60		ns
t_{su} Setup time, $\overline{CE1}$ and $\overline{CE2}$ before $\overline{IORD}/\overline{IOWR}$ low	T14	60		ns
t_{su} Setup time, CA25–CA0 valid before $\overline{IORD}/\overline{IOWR}$ low	T15	$t_{su(A)}+2PCLK$		ns
t_{pd} Propagation delay time, $\overline{IOIS16}$ low after CA25–CA0 valid	T16		35	ns
t_{pd} Propagation delay time, \overline{IORD} low to \overline{WAIT} low	T17	35		ns
t_w Pulse duration, $\overline{IORD}/\overline{IOWR}$ low	T18	T_{CA}		ns
t_h Hold time, \overline{IORD} low after \overline{WAIT} high	T19			ns
t_h Hold time, \overline{REG} low after \overline{IORD} high	T20	0		ns
t_h Hold time, $\overline{CE1}$ and $\overline{CE2}$ after $\overline{IORD}/\overline{IOWR}$ high	T21	120		ns
t_h Hold time, CA25–CA0 after $\overline{IORD}/\overline{IOWR}$ high	T22	$t_{h(A)}+1PCLK$		ns
t_{su} Setup time (read), CDATA15–CDATA0 valid before \overline{IORD} high	T23	10		ns
t_h Hold time (read), CDATA15–CDATA0 valid after \overline{IORD} high	T24	0		ns
t_{su} Setup time (write), CDATA15–CDATA0 valid before \overline{IOWR} low	T25	90		ns
t_h Hold time (write), CDATA15–CDATA0 valid after \overline{IOWR} high	T26	90		ns

8.11 Switching Characteristics Over Recommended Ranges of Supply Voltage and Operating Free-Air Temperature, Miscellaneous (see Figure 8–7)

PARAMETER		ALTERNATE SYMBOL	MIN	MAX	UNIT
t _{pd}	Propagation delay time	BVD2 low to SPKROUT low		30	ns
		BVD2 high to SPKROUT high	T27	30	
		IREQ to IRQ15–IRQ3		30	
		STSCHG to IRQ15–IRQ3	T28	30	

8.12 PC Card Parameter Measurement Information

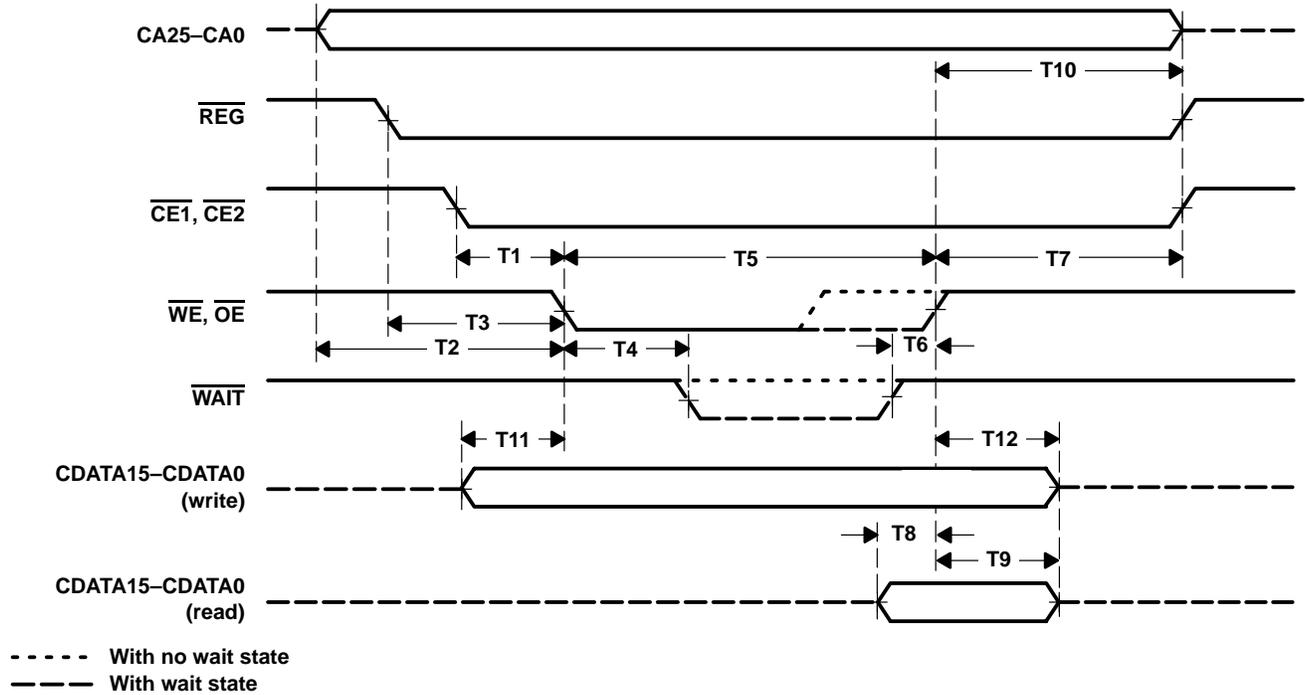


Figure 8–5. PC Card Memory Cycle

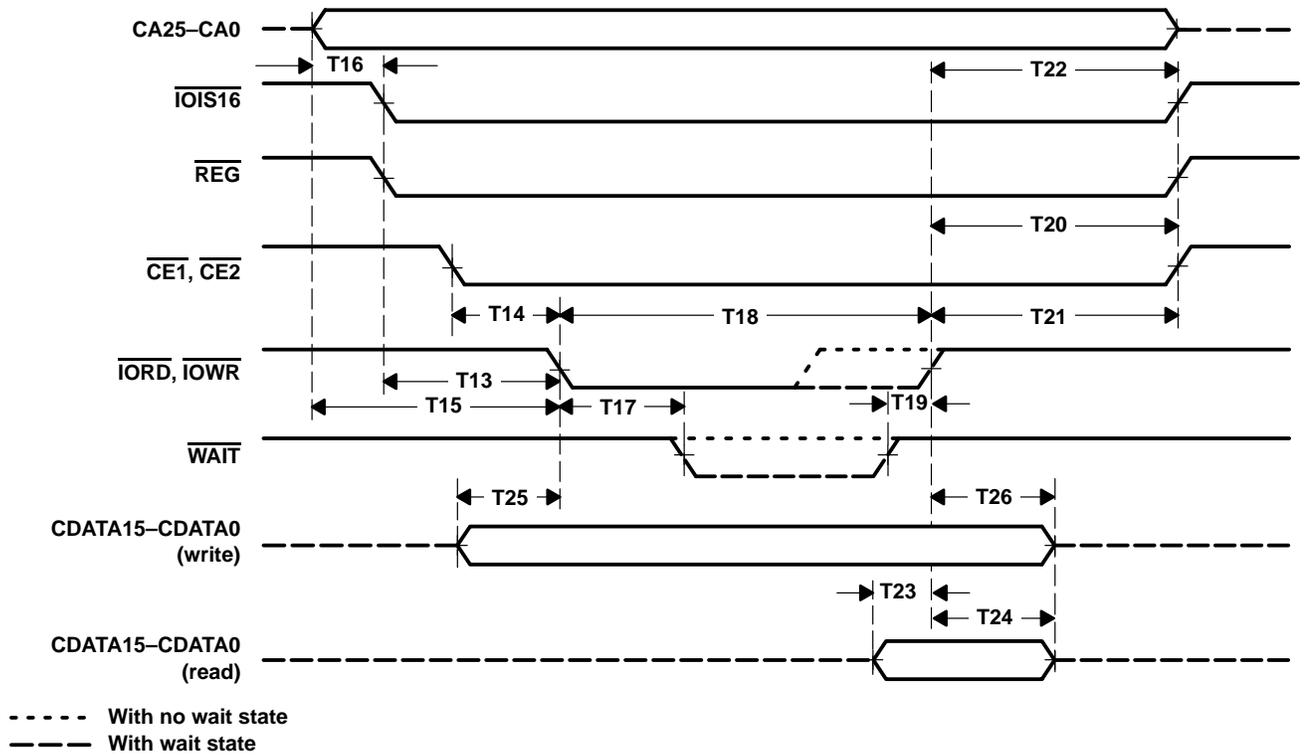


Figure 8-6. PC Card I/O Cycle

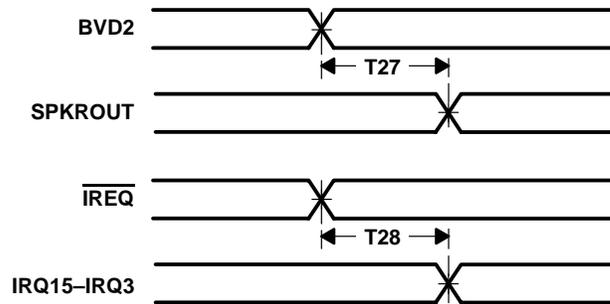
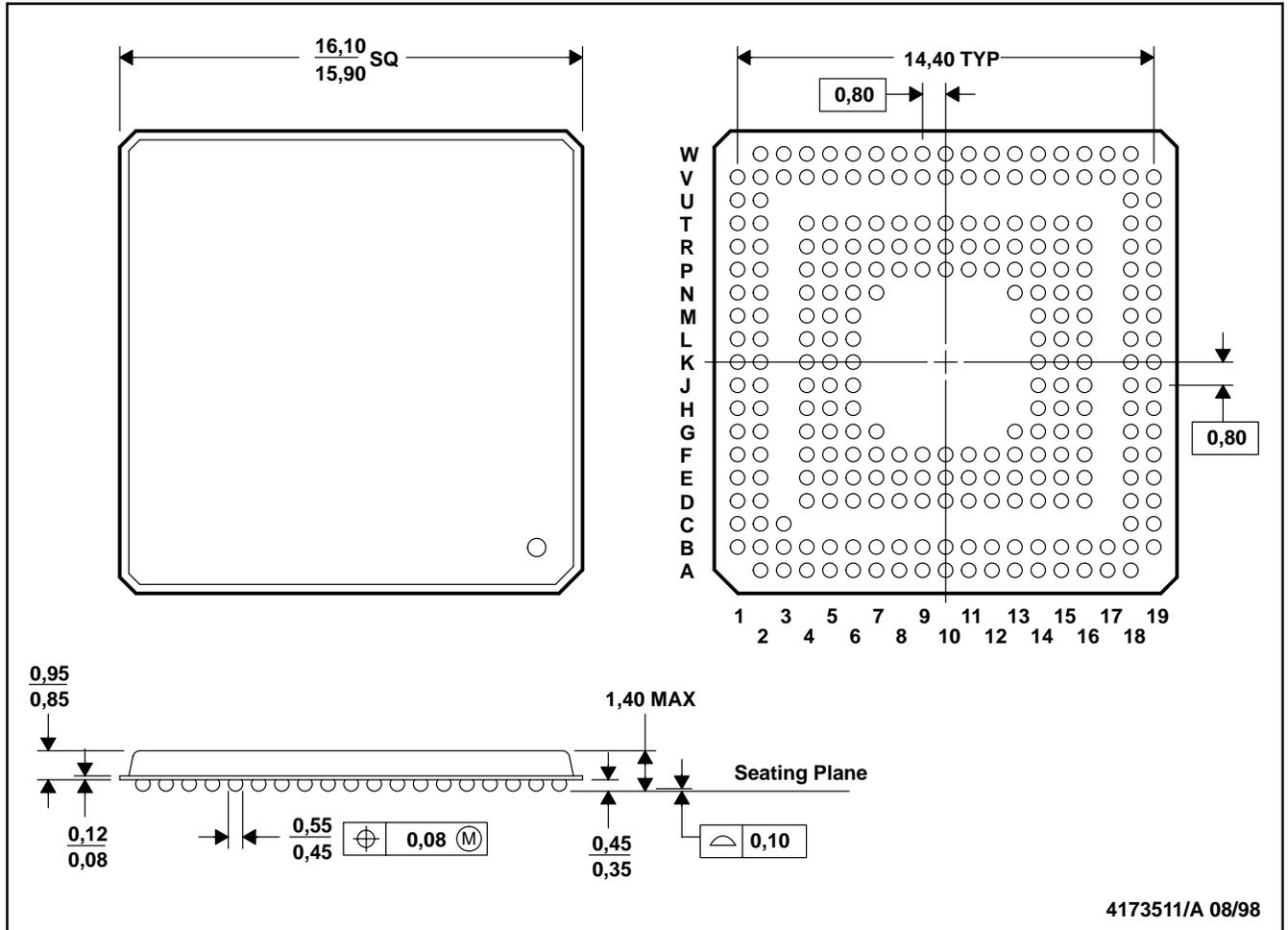


Figure 8-7. Miscellaneous PC Card Delay Times

9 Mechanical Data

GJG (S-PBGA-N257)

PLASTIC BALL GRID ARRAY



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. MicroStar BGA™ configuration

MicroStar BGA is a trademark of Texas Instruments.

