



**Preliminary**  
September 2003  
Revision 1.0

## PC8374L SensorPath™ SuperI/O with Glue Functions

### General Description

The National Semiconductor PC8374L Advanced I/O product is a member of the PC8737x SuperI/O family. All PC8737x devices are highly integrated and are pin and software compatible, thus providing drop-in interchangeability and enabling a variety of assembly options using only a single motherboard and BIOS.

PC8374L integration allows for a smaller system board size and saves on total system cost.

The PC8374L includes legacy SuperI/O functions, system glue functions, health monitoring and control, commonly used functions such as GPIO, and ACPI-compliant Power Management support.

The PC8374L integrates miscellaneous analog and digital system glue functions to reduce the number of discrete components required. The host communicates with the functions integrated in the PC8374L device through an LPC Bus Interface.

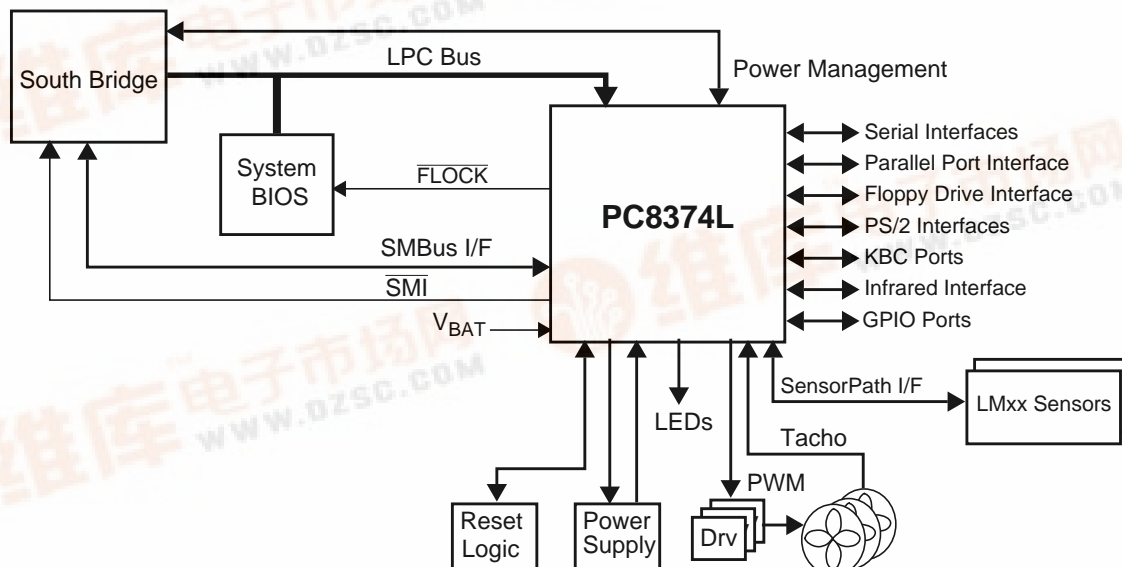
The PC8374L extended wake-up support complements the ACPI controller in the chipset. The System Wake-Up Control (SWC) module, powered by  $V_{SB3}$ , supports a flexible wake-up mechanism.

The PC8374L supports both I/O and memory mapping of module registers and enables building legacy-free systems.

### Outstanding Features

- SensorPath™ interface to LMxx sensor devices for system health support
- Fan monitor and control
- Heceta6-compatible register set, accessible via the LPC interface and SMBus
- Glue functions to complement the South Bridge functionality including flash and FDD write-protect controls
- $V_{SB3}$ -powered Power Management with 19 wake-up sources
- Controls three LED indicators
- 16 GPIO ports with a variety of wake-up options
- I/O-mapped and memory-mapped registers.
- Legacy modules: Parallel Port, Floppy Disk Controller (FDC), two Serial Ports, Slow InfraRed Port and a Keyboard and Mouse Controller (KBC)
- LPC interface, based on Intel's *LPC Interface Specification Revision 1.1, August 2002*
- *PC01 Revision 1.0* and *Advanced Configuration and Power Interface (ACPI) Specification Revision 2.0* compliant
- 128-pin PQFP package

### Block Diagram



## Features

### System Health Support

- SensorPath interface to sensors optimizes digital/analog partitioning
  - Simplifies board design and routing
  - Supports distributed sensors and centralized control
  - Health monitoring is self-contained and requires minimal host attention
  - Faster boot time
  - Off loads SMBus, and enables ASF compliance
- Fan Monitor and Control
  - Three PWM-based fan controls
  - Four 16-bit resolution tachometer inputs
  - Software or local temperature feedback control
- Heceta6-compatible register set accessible via the LPC interface and SMBus
  - Supports the following combinations of LMxx devices:
    - LM41 and optional LM30
    - LM32
    - LM40
  - Simultaneous read support via LPC interface and SMBus
- Generates SMI on critical temperature event

### Glue Functions

- Flash Write Protect control (using GPIO) with optional SMI generation when cleared
- Floppy Disk Drive Write Protect (WGATE) lockable control (cleared only by hardware reset)
- Generates the power-related signals:
  - Main Power good
  - Power distribution control (for switching between Main and Standby regulators)
  - Resume reset (Master Reset) according to the 5V standby supply status
  - Main power supply turn on ( $\overline{\text{PS\_ON}}$ )
- Voltage translation between 2.5V or 3.3V levels (DDC) and 5V levels (VGA) for the SMBus serial clock and data signals
- Isolation circuitry for the SMBus serial clock and data signals
- Buffers  $\text{PCI\_RESET}$  to generate three reset output signals
- Buffers  $\text{PWRGD\_PS}$  to generate IDE reset output.
- Generates “highest active supply” reference voltage
  - Based on 3.3V and 5V Main supplies
  - Based on 3.3V and 5V Standby supplies
- High-current LED driver control for Hard Disk Drive activity indication
- Software selectable alternative functionality, through pin multiplexing

### General-Purpose I/O (GPIO) Ports

- All 16 GPIO ports powered by  $V_{\text{SB3}}$
- Each pin individually configured as input or output
- Programmable features for each output pin:
  - Drive type (open-drain, push-pull or TRI-STATE®)

- TRI-STATE on detection of falling  $V_{\text{DD3}}$  for  $V_{\text{SB3}}$ -powered pins driving  $V_{\text{DD}}$ -supplied devices
- Programmable option for internal pull-up resistor on each input pin (some with internal pull-down resistor option)
- Lock option for the configuration and data of each output pin
- 15 GPIO ports generate  $\text{IRQ}/\text{SMI}/\text{SIOPME}$  for wake-up events; each GPIO has separate:
  - Enable control of event status routing to IRQ
  - Enable control of event status routing to  $\text{SMI}$
  - Enable control of event status routing to  $\text{SIOPME}$  (via SWC)
  - Polarity and edge/level selection
    - Programmable debouncing

### Power Management

- Supports *ACPI Specification Revision 2.0b, July 27, 2000*
- System Wake-Up Control (SWC)
  - Optional routing of events to generate SCI ( $\text{SIOPME}$ ) on detection of:
    - Keyboard or Mouse events
    - Ring Indication  $\overline{\text{RI}}$  on each of the two serial ports
    - General-Purpose Input Events from 15 GPIO pins
    - IRQs of the Keyboard and Mouse Controller
    - IRQs of the other internal modules
  - Optional routing of the SCI ( $\text{SIOPME}$ ) to generate IRQ (SERIRQ)
  - Implements the GPE1\_BLK of the ACPI General Purpose (Generic) Register blocks with “child” events
  - $V_{\text{SB3}}$ -powered event detection and event-logic configuration
- Enhanced Power Management (PM), including:
  - Special configuration registers for power down
  - Low-leakage pins
  - Low-power CMOS technology
  - Ability to disable all modules
  - High-current LED drivers control (two LEDs) for power status indication with:
    - Standard blinking, controlled by software
    - Advanced blinking, controlled by power supply status, sleep state or software
    - Special blinking, controlled by power supply status, sleep state and software bit
  - $V_{\text{BAT}}$ -powered indication of the Main power supply state before an AC power failure
- Keyboard Events
  - Wake-up on any key
  - Supports programmable 8-byte sequence “Password” or “Special Keys” for Power Management
  - Simultaneous recognition of three programmable keys (sequences): “Power”, “Sleep” and “Resume”
  - Wake-up on mouse movement and/or button click

## Features (Continued)

### Bus Interface

- **LPC Bus Interface**
  - Based on Intel's *LPC Interface Specification Revision 1.1, August 2002*
  - I/O, Memory and 8-bit Firmware Memory read and write cycles
  - Up to four 8-bit DMA channels
  - Serial IRQ (SERIRQ)
  - Supports registers memory and I/O mapping
- **Configuration Control**
  - PnP Configuration Register structure
  - *PC01 Specification Revision 1.0, 1999-2000* compliant
  - Base Address strap (BADDR) to setup the address of the Index-Data register pair (defaults to 2Eh/2Fh)
  - Flexible resource allocation for all logical devices:
    - Relocatable base address
    - 15 IRQ routing options to serial IRQ
    - Up to four optional 8-bit DMA channels
  - Configurable feature sets:
    - Software selectable
    - V<sub>SB3</sub>-powered pin multiplexing

### Legacy Modules

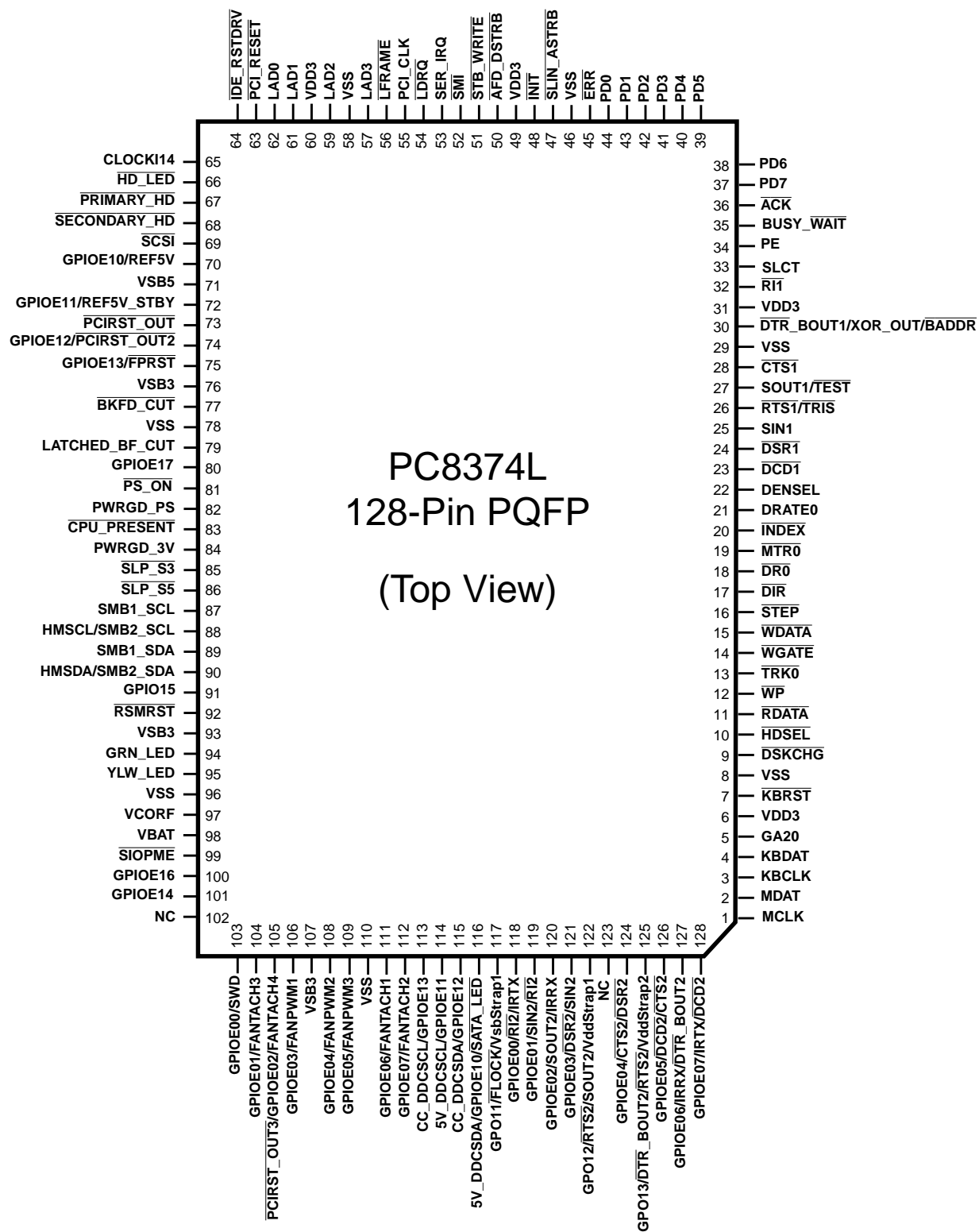
- **Serial Ports 1 and 2**
  - Software-compatible with the NS16550A and NS16450
  - Support shadow register for write-only bit monitoring
  - Data rates up to 1.5 Mbaud
- **Serial Infrared Port (SIR)**
  - Software compatible with the 16550A and the 16450
  - Shadow register support for write-only bit monitoring
  - HP-SIR
  - ASK-IR option of SHARP-IR
  - DASK-IR option of SHARP-IR
  - Consumer Remote Control supports RC-5, RC-6, NEC, RCA and RECS 80
- **IEEE 1284-compliant Parallel Port**
  - ECP, with Level 2 (14 mA sink and source output buffers)
  - Software or hardware control
  - Enhanced Parallel Port (EPP) compatible with EPP 1.7 and EPP 1.9
  - Supports EPP as mode 4 of the Extended Control Register (ECR)
  - Selection of internal pull-up or pull-down resistor for Paper End (PE) pin
  - Supports a demand DMA mode mechanism and a DMA fairness mechanism for improved bus utilization
  - Protection circuit that prevents damage to the parallel port when a printer connected to it is powered up or is operated at high voltages (in both cases, even if the PC8374L is in power-down state)
- **Floppy Disk Controller (FDC)**
  - Software compatible with the PC8477 (the PC8477 contains a superset of the FDC functions in the  $\mu$ DP8473, NEC  $\mu$ PD765A/B and N82077 devices)

- Error-free handling of data overrun and underrun
- Programmable write protect
- Supports FM and MFM modes
- Supports Enhanced mode command for three-mode Floppy Disk Drive (FDD)
- Perpendicular recording drive support for 2.88 MBytes
- Burst (16-byte FIFO) and Non-Burst modes
- Full support for IBM Tape Drive Register (TDR) implementation of AT and PS/2 drive types
- High-performance digital separator
- Supports fast tape drives (2 Mbps) and standard tape drives (1 Mbps, 500 Kbps and 250 Kbps)
- **Keyboard and Mouse Controller (KBC)**
  - 8-bit microcontroller, software compatible with 8042AH and PC87911
  - Standard interface (60h, 64h, IRQ1 and IRQ12)
  - Supports two external swappable PS/2 interfaces for keyboard and mouse
  - Programmable, dedicated quasi-bidirectional I/O lines (GA20/P21, KBRST/P20)

### Clocking, Supply, and Package Information

- **Clocks**
  - LPC (PCI) clock input (up to 33 MHz)
  - On-chip Clock Generator:
    - Generates 48 MHz clock
    - Generates 32.768 KHz internal clock
    - V<sub>SB3</sub> powered
    - Based on the 14.31818 MHz clock input
- **Protection**
  - All pins are 5V tolerant and back-drive protected (except LPC bus pins)
  - High ESD protection of all the pins
  - Pin multiplexing selection lock
  - Configuration register lock
- **Testability**
  - XOR tree structure
    - Includes all the pins (except supply and analog pins)
    - Selected at power-up by strap input ( $\overline{\text{TEST}}$ )
  - TRI-STATE pins, selected at power-up by strap input (TRIS)
- **Power Supply**
  - 3.3V supply operation
  - Separate pin pairs for main (V<sub>DD3</sub>) and standby (V<sub>SB3</sub>) power supplies
  - Backup battery input (V<sub>BAT</sub>) for SWC indications
  - Low standby power consumption
  - Very low power consumption from backup battery (less than 0.5  $\mu$ A)
- **Package**
  - 128-pin PQFP

1.0 Signal/Pin Connection and Description  
1.1 CONNECTION DIAGRAM



Plastic Quad Flatpack (PQFP), JEDEC  
Order Number TBD  
See NS Package Number VLA128A

# 1.0 Signal/Pin Connection and Description (Continued)

Pin	Pin Name	Pin	Pin Name	Pin	Pin Name	Pin	Pin Name
1	MCLK	33	SLCT	65	CLOCKI14	97	V <sub>CORF</sub>
2	MDAT	34	PE	66	HD_LED	98	V <sub>BAT</sub>
3	KBCLK	35	BUSY_WAIT	67	PRIMARY_HD	99	SIOPME
4	KBDAT	36	ACK	68	SECONDARY_HD	100	GPIOE16
5	GA20	37	PD7	69	SCSI	101	GPIOE14
6	V <sub>DD3</sub>	38	PD6	70	REF5V/GPIOE10	102	NC
7	KBRST	39	PD5	71	V <sub>SB5</sub>	103	SWD/GPIOE00
8	V <sub>SS</sub>	40	PD4	72	REF5V_STBY/GPIOE11	104	FANTACH3/GPIOE01
9	DSKCHG	41	PD3	73	PCIRST_OUT	105	PCIRST_OUT3/ FANTACH4/GPIOE02
10	HDSEL	42	PD2	74	PCIRST_OUT2/GPIOE12	106	FANPWM1/GPIOE03
11	RDATA	43	PD1	75	FPRST/GPIOE13	107	V <sub>SB3</sub>
12	WP	44	PD0	76	V <sub>SB3</sub>	108	FANPWM2/GPIOE04
13	TRK0	45	ERR	77	BKFD_CUT	109	FANPWM3/GPIOE05
14	WGATE	46	V <sub>SS</sub>	78	V <sub>SS</sub>	110	V <sub>SS</sub>
15	WDATA	47	SLIN_ASTRB	79	LATCHED_BF_CUT	111	FANTACH1/GPIOE06
16	STEP	48	INIT	80	GPIOE17	112	FANTACH2/GPIOE07
17	DIR	49	V <sub>DD3</sub>	81	PS_ON	113	CC_DDCSCL/GPIOE13
18	DR0	50	AFD_DSTRB	82	PWRGD_PS	114	5V_DDCSCL/GPIOE11
19	MTR0	51	STB_WRITE	83	CPU_PRESENT	115	CC_DDCSDA/GPIOE12
20	INDEX	52	SMI	84	PWRGD_3V	116	5V_DDCSDA/GPIOE10/ SATA_LED
21	DRATE0	53	SER_IRQ	85	SLP_S3	117	GPO11/FLOCK/VsbStrap1
22	DENSEL	54	LDRQ	86	SLP_S5	118	GPIOE00/RI2/IRTX
23	DCD1	55	PCI_CLK	87	SMB1_SCL	119	GPIOE01/SIN2/RI2
24	DSR1	56	LFRAME	88	SMB2_SCL/HMSCL	120	GPIOE02/SOUT2/IRRX
25	SIN1	57	LAD3	89	SMB1_SDA	121	GPIOE03/DSR2/SIN2
26	RTS1/TRIS	58	V <sub>SS</sub>	90	SMB2_SDA/HMSDA	122	GPO12/RTS2/SOUT2/ VddStrap1
27	SOUT1/TEST	59	LAD2	91	GPIO15	123	NC
28	CTS1	60	V <sub>DD3</sub>	92	RSMRST	124	GPIOE04/CTS2/DSR2
29	V <sub>SS</sub>	61	LAD1	93	V <sub>SB3</sub>	125	GPO13/DTR_BOUT2/ RTS2/VddStrap2
30	DTR_BOUT1/BADDR/ XOR_OUT	62	LAD0	94	GRN_LED	126	GPIOE05/DCD2/CTS2
31	V <sub>DD3</sub>	63	PCI_RESET	95	YLW_LED	127	GPIOE06/IRRX/ DTR_BOUT2
32	RI1	64	IDE_RSTDRV	96	V <sub>SS</sub>	128	GPIOE07/IRTX/DCD2

## 1.0 Signal/Pin Connection and Description (Continued)

### 1.2 BUFFER TYPES AND SIGNAL/PIN DIRECTORY

The signal DC characteristics of the pins described in Section 1.4 on page 12 are denoted by buffer type symbols, which are defined in Table 1 and described in further detail in Section 2.2 on page 24.

**Table 1. Buffer Types**

Symbol	Description
IN <sub>T</sub>	Input, TTL compatible
IN <sub>TS</sub>	Input, TTL compatible, with 250 mV Schmitt Trigger
IN <sub>TS2</sub>	Input, TTL compatible, with 200 mV Schmitt Trigger
IN <sub>TS4</sub>	Input, TTL compatible, with 400 mV Schmitt Trigger
IN <sub>PCI</sub>	Input, PCI 3.3V compatible
IN <sub>SM</sub>	Input, SMBus compatible
IN <sub>ULR</sub>	Input, power, resistor protected (not characterized)
AI	Input, analog (0-5.5V tolerant)
O <sub>p/n</sub>	Output, TTL/CMOS compatible, push-pull buffer capable of sourcing $p$ mA and sinking $n$ mA
OD <sub>n</sub>	Output, TTL/CMOS compatible, open-drain buffer capable of sinking $n$ mA
O <sub>PCI</sub>	Output, PCI 3.3V compatible,
AO	Output, analog (0-5.5V tolerant)
SW <sub>SM</sub>	Input/Output switch, SMBus compatible
PWR	Power pin
GND	Ground pin

### 1.3 PIN MULTIPLEXING

Table 2 shows only multiplexed pins, their associated functional blocks and the configuration bits for the selection of the multiplexed options used in the PC8374L.

Table 2. Pin Multiplexing Configuration

Pin	Default Signal	Function Block	Alternate Signal	Function Block	Alternate Signal	Function Block	Configuration Select	Strap or Wake-Up	Function Block
26	RTS1	Serial Port 1						TRIS	Config (Straps)
27	SOUT1							TEST	
30	DTR_BOUT1	Glue	XOR_OUT	Config			TEST (strap)	BADDR	SWC
70	REF5V		GPIOE10	GPIO			SIOCF4.nREF5V	GPIOE10	
72	REF5V_STBY		GPIOE11					GPIOE11	
74	PCIRST_OUT2		GPIOE12					GPIOE12	
75	GPIOE13	GPIO	FPRST	Glue			SIOCF4.FPRST	GPIOE13	SWC
105	PCIRST_OUT3	Glue	GPIOE02	GPIO	FANTACH4	HM	SIOCF4.PCIRST_OUT3_DIS AND SIOCF2.TACH4EN	GPIOE02	
103	SWD	HM	GPIOE00	GPIO			SIOCF4.nSWD	GPIOE00	SWC
104	GPIOE01	GPIO	FANTACH3	HM			SIOCF2.TACH3EN	GPIOE01	
106	GPIOE03		FANPWM1				SIOCF3.PWM1EN	GPIOE03	
108	GPIOE04		FANPWM2				SIOCF3.PWM2EN	GPIOE04	
109	GPIOE05		FANPWM3				SIOCF3.PWM3EN	GPIOE05	
111	GPIOE06		FANTACH1				SIOCF2.TACH1EN	GPIOE06	
112	GPIOE07		FANTACH2				SIOCF2.TACH2EN	GPIOE07	
113	CC_DDCSCL	Glue	GPIOE13	GPIO			SIOCF2.GPIO03EN	GPIOE13	
114	5V_DDCSCL		GPIOE11					GPIOE11	
115	CC_DDCSDA		GPIOE12					GPIOE12	
116	5V_DDCSDA		GPIOE10					SATA_LED	Glue
117	GPO11	GPIO	FLOCK	Glue <sup>1</sup>			SIOCF2.GPIO03EN AND SIOCF3.SATALEDEN	VsbStrap1 <sup>2</sup>	Strap

Table 2. Pin Multiplexing Configuration (Continued)

Pin	Default Signal	Function Block	Alternate Signal	Function Block	Alternate Signal	Function Block	Configuration Select	Strap or Wake-Up	Function Block
118 GPIOE00		GPIO	$\overline{\text{RI2}}$	InfraRed	IRTX	SIOCF3.373COMP AND SIOCF3.SP2EN AND SIOCF3.IREN	$\overline{\text{RI2}}$	$\overline{\text{RI2}}$	SWC
119 GPIOE01			SIN2		$\overline{\text{RI2}}$				
120 GPIOE02			SOUT2	Serial Port 2	IRRX	SIOCF3.373COMP AND SIOCF3.SP2EN AND SIOCF3.IREN	$\overline{\text{RI2}}$	$\overline{\text{RI2}}$	
121 GPIOE03			$\overline{\text{DSR2}}$		SIN2				
122 GPO12			$\overline{\text{RTS2}}$	Serial Port 2	SOUT2	SIOCF3.373COMP AND SIOCF3.SP2EN		VddStrap <sup>13</sup>	Config (Straps)
124 GPIOE04			$\overline{\text{CTS2}}$		$\overline{\text{DSR2}}$				
125 GPO13			$\overline{\text{DTR\_BOUT2}}$		$\overline{\text{RTS2}}$				
126 GPIOE05			$\overline{\text{DCD2}}$		$\overline{\text{CTS2}}$				
127 GPIOE06			IRRX	InfraRed	$\overline{\text{DTR\_BOUT2}}$	SIOCF3.373COMP AND SIOCF3.SP2EN AND SIOCF3.IREN		VddStrap <sup>24</sup>	Config (Straps)
128 GPIOE07			IRTX		$\overline{\text{DCD2}}$				

1.  $\overline{\text{FLOCK}}$  functionality is achieved by controlling GPIOE11 and enabling the corresponding event routing to SMI.
2.  $V_{\text{SB}}$  strap input. Reserved for National use.
3.  $V_{\text{DD}}$  strap input. Reserved for National use. Will be used for PC8374T.
4. Will be used for PC8374T.



## 1.0 Signal/Pin Connection and Description (Continued)

The following table shows the selection of GPIOs on their respective pins:

**Table 3. GPIO Selection on Pins**

GPIO	Configuration Bits					Selected On Pin	Comments
GPIOE00	SIOCF4.7	SIOCF3.0	SIOCF3.1	SIOCF3.2			Default
	0	X	0	0		118	
	0		1			None	
	1		0			Undefined	
	1		1			103	
	0	0	X	1		118	
	0	1				None	
	1	0				Undefined	
	1	1				103	
	GPIOE01	SIOCF2.1	SIOCF3.1				
0		0	104				
0		1	104				
1		0	119				
1		1	None				
GPIOE02	SIOCF4.6	SIOCF2.2	SIOCF3.0	SIOCF3.1	SIOCF3.2		Default
	0	X	X	0	0	120	
	0	X		1		None	
	1	0		0		105	
	1	0		1		105	
	1	1		0		120	
	1	1		1		None	
	0	X	0	X	1	120	
	0	X	1			None	
	1	0	0			105	
	1	0	1			105	
	1	1	0			120	
	1	1	1			None	
GPIOE03	SIOCF3.5	SIOCF3.1					Default
	0	0				106	
	0	1				106	
	1	0				121	
	1	1				None	

# 1.0 Signal/Pin Connection and Description (Continued)

Table 3. GPIO Selection on Pins

GPIO	Configuration Bits					Selected On Pin	Comments
GPIOE04	SIOCF3.6	SIOCF3.1					Default
	0	0				108	
	0	1				108	
	1	0				124	
	1	1				None	
GPIOE05	SIOCF3.7	SIOCF3.1					Default
	0	0				109	
	0	1				109	
	1	0				126	
	1	1				None	
GPIOE06	SIOCF2.4	SIOCF3.0	SIOCF3.1	SIOCF3.2			Default
	0	0	X	0		111	
	0	1				111	
	1	0				127	
	1	1				None	
	0	X	0	1		111	
	0		1			111	
	1		0			127	
	1		1			None	
	GPIOE07	SIOCF2.5	SIOCF3.0	SIOCF3.1		SIOCF3.2	
0		0	X	0	112		
0		1			112		
1		0			128		
1		1			None		
0		X	0	1	112		
0			1		112		
1			0		128		
1			1		None		
GPIOE10		SIOCF3.4	SIOCF2.0	SIOCF4.5			
	0	0	0	None			
		0	1	70			
		1	0	116			
		1	1	Undefined			
	1	X	0	None			
		X	1	70			

## 1.0 Signal/Pin Connection and Description (Continued)

Table 3. GPIO Selection on Pins

GPIO	Configuration Bits					Selected On Pin	Comments
GPIOE11, GPO11	SIOCF2.0	SIOCF4.5					Default
	0	0				117	
	0	1				72	
	1	0				114	
	1	1				Undefined	
GPIOE12, GPO12	SIOCF2.0	SIOCF3.1	SIOCF4.4				Default
	0	0	0			122	
	0	X	1			74	
	0	1	0			None	
	1	X	0			115	
	1	X	1			Undefined	
GPIOE13, GPO13	SIOCF2.0	SIOCF3.1	SIOCF4.3	VsbStrap1			Default
	0	X	0	1		75	
	0	0	1	X		125	
	0	1	1	X		None	
	1	X	X	X		113	

## 1.0 Signal/Pin Connection and Description (Continued)

### 1.4 DETAILED SIGNAL/PIN DESCRIPTIONS

This section describes all signals of the PC8374L device. The signals are organized by functional group.

#### 1.4.1 LPC Interface

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
LAD3-0	57,59 61,62	I/O	IN <sub>PCI</sub> /O <sub>PCI</sub>	V <sub>DD3</sub>	<b>LPC Address-Data.</b> Multiplexed command, address bi-directional data and cycle status.
PCI_CLK	55	I	IN <sub>PCI</sub>	V <sub>DD3</sub>	<b>LPC Clock.</b> PCI clock used for the LPC bus (up to 33 MHz).
LFRAME	56	I	IN <sub>PCI</sub>	V <sub>DD3</sub>	<b>LPC Frame.</b> Low pulse indicates the beginning of a new LPC cycle or termination of a broken cycle.
LDRQ	54	O	O <sub>PCI</sub>	V <sub>DD3</sub>	<b>LPC DMA Request.</b> Encoded DMA request for LPC interface.
PCI_RESET	63	I	IN <sub>PCI</sub>	V <sub>DD3</sub>	<b>LPC Reset.</b> PCI system reset used for the LPC bus (Hardware Reset).
SER_IRQ	53	I/O	IN <sub>PCI</sub> /O <sub>PCI</sub>	V <sub>DD3</sub>	<b>Serial IRQ.</b> The interrupt requests are serialized over a single pin, where each IRQ level is delivered during a designated time slot.
SMI	52	O	OD <sub>6</sub>	V <sub>DD3</sub>	<b>System Management Interrupt.</b> Active (low) level indicates that an SMI occurred. External pull-up resistor to V <sub>DD3</sub> is required.
PCIRST_OUT	73	O	O <sub>14/14</sub>	V <sub>SB3</sub>	<b>PCI Reset Output.</b> PCI system reset. PCIRST_OUT is a buffered copy of PCI_RESET when V <sub>DD3</sub> is on, and it is held at low level when V <sub>DD3</sub> is off.
PCIRST_OUT2	74	O	O <sub>14/14</sub>	V <sub>SB3</sub>	<b>PCI Reset Output 2.</b> PCI system reset (same behavior as PCIRST_OUT above).
PCIRST_OUT3	105	O	O <sub>14/14</sub>	V <sub>DD3</sub>	<b>PCI Reset Output 3.</b> PCI system reset (same behavior as PCIRST_OUT).
IDE_RSTDRV	64	O	OD <sub>6</sub>	V <sub>DD3</sub>	<b>IDE Reset Output.</b> IDE drive reset. IDE_RSTDRV is a buffered copy of PCI_RESET or PWRGD_PS (see TBD) when V <sub>DD3</sub> is on, and it is floating when V <sub>DD3</sub> is off.

#### 1.4.2 Serial Port 1 and Serial Port 2 (UART1 and UART2)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
CTS1	28	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Clear to Send.</b> When low, indicates that the modem or other data transfer device is ready to exchange data.
CTS2	124 or 126	I	IN <sub>TS</sub>	V <sub>DD3</sub>	
DCD1	23	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Data Carrier Detected.</b> When low, indicates that the modem or other data transfer device has detected the data carrier.
DCD2	126 or 128	I	IN <sub>TS</sub>	V <sub>DD3</sub>	
DSR1	24	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Data Set Ready.</b> When low, indicates that the data transfer device, e.g., modem, is ready to establish a communications link.
DSR2	121 or 124	I	IN <sub>TS</sub>	V <sub>DD3</sub>	
DTR_BOUT1	30	O	O <sub>4/8</sub>	V <sub>DD3</sub>	<b>Data Terminal Ready.</b> When low, indicates to the modem or other data transfer device that the UART is ready to establish a communications link. After a system reset, these pins provide the DTR function and set these signals to inactive high. Loopback operation holds them inactive.  <b>Baud Output.</b> Provides the associated serial channel baud rate generator output signal if test mode is selected, i.e., bit 7 of EXCR1 register is set.
DTR_BOUT2	125 or 127	O	O <sub>4/8</sub>	V <sub>DD3</sub>	

## 1.0 Signal/Pin Connection and Description (Continued)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
RI1	32	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Ring Indicator.</b> When low, indicates that a telephone ring signal was received by the modem. These pins are monitored during V <sub>DD</sub> power-off for wake-up event detection.
RI2	118 or 119	I	IN <sub>TS</sub>	V <sub>DD3</sub>	
RTS1	26	O	O <sub>4/8</sub>	V <sub>DD3</sub>	<b>Request to Send.</b> When low, indicates to the modem or other data transfer device that the corresponding UART is ready to exchange data. A system reset sets these signals to inactive high, and loopback operation holds them inactive.
RTS2	122 or 125	O	O <sub>4/8</sub>	V <sub>DD3</sub>	
SIN1	25	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Serial Input.</b> Receives composite serial data from the communications link (peripheral device, modem or other data transfer device).
SIN2	119 or 121	I	IN <sub>TS</sub>	V <sub>DD3</sub>	
SOUT1	27	O	O <sub>4/8</sub>	V <sub>DD3</sub>	<b>Serial Output.</b> Sends composite serial data to the communications link (peripheral device, modem or other data transfer device). These signals are set active high after a system reset.
SOUT2	120 or 122	O	O <sub>4/8</sub>	V <sub>DD3</sub>	

### 1.4.3 InfraRed Port

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
IRRX	127 or 120	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>InfraRed Receive.</b> InfraRed serial input data.
IRTX	128 or 118	O	O <sub>6/12</sub>	V <sub>DD3</sub>	<b>InfraRed Transmit.</b> InfraRed serial output data.

### 1.4.4 Parallel Port

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
ACK	36	I	IN <sub>T</sub>	V <sub>DD3</sub>	<b>Acknowledge.</b> Pulsed low by the printer to indicate that it has received data from the parallel port.
AFD_DSTRB	50	O	OD <sub>14</sub> , O <sub>14/14</sub>	V <sub>DD3</sub>	<b>AFD - Automatic Feed.</b> When low, instructs the printer to automatically feed a line after printing each line. This pin is in TRI-STATE after a 0 is loaded into the corresponding control register bit. An external 4.7 KΩ pull-up resistor must be connected to this pin. <b>DSTRB - Data Strobe (EPP).</b> Active low; used in EPP mode to denote a data cycle. When the cycle is aborted, DSTRB becomes inactive (high).
BUSY_WAIT	35	I	IN <sub>T</sub>	V <sub>DD3</sub>	<b>Busy.</b> Set high by the printer when it cannot accept another character. <b>Wait.</b> In EPP mode, the parallel port device uses this active low signal to extend its access cycle.
ERR	45	I	IN <sub>T</sub>	V <sub>DD3</sub>	<b>Error.</b> Set active low by the printer when it detects an error.
INIT	48	O	OD <sub>14</sub> , O <sub>14/14</sub>	V <sub>DD3</sub>	<b>Initialize.</b> When low, initializes the printer. This signal is in TRI-STATE after a 1 is loaded into the corresponding control register bit. An external 4.7 KΩ pull-up resistor must be connected to this pin.
PD7-0	37-44	I/O	IN <sub>T</sub> /O <sub>14/14</sub>	V <sub>DD3</sub>	<b>Parallel Port Data.</b> Transfers data to and from the peripheral data bus and the appropriate parallel port data register. These signals have a high current drive capability.
PE	34	I	IN <sub>T</sub>	V <sub>DD3</sub>	<b>Paper End.</b> Set high by the printer when it is out of paper. This pin has an internal weak pull-up or pull-down resistor.

## 1.0 Signal/Pin Connection and Description (Continued)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
SLCT	33	I	IN <sub>T</sub>	V <sub>DD3</sub>	<b>Select.</b> Set active high by the printer when the printer is selected.
SLIN_ASTRB	47	O	OD <sub>14</sub> , O <sub>14/14</sub>	V <sub>DD3</sub>	<p><b>SLIN - Select Input.</b> When low, selects the printer. This signal is in TRI-STATE after a 0 is loaded into the corresponding control register bit. An external 4.7 K<math>\Omega</math> pull-up resistor must be connected to this pin.</p> <p><b>ASTRB - Address Strobe (EPP).</b> Active low, used in EPP mode to denote an address or data cycle. When the cycle is aborted, ASTRB becomes inactive (high).</p>
STB_WRITE	51	O	OD <sub>14</sub> , O <sub>14/14</sub>	V <sub>DD3</sub>	<p><b>STB - Data Strobe.</b> When low, Indicates to the printer that valid data is available at the printer port. This signal is in TRI-STATE after a 0 is loaded into the corresponding control register bit. An external 4.7 K<math>\Omega</math> pull-up resistor must be connected to this pin.</p> <p><b>WRITE - Write Strobe.</b> Active low, used in EPP mode to denote an address or data cycle. When the cycle is aborted, WRITE becomes inactive (high).</p>

### 1.4.5 Floppy Disk Controller (FDC)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
DENSEL	22	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Density Select.</b> Indicates that a high FDC density data rate (500 Kbps, 1 Mbps or 2 Mbps) or a low density data rate (250 or 300 Kbps) is selected.
DIR	17	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Direction.</b> Determines the direction of the Floppy Disk Drive (FDD) head movement (active = step in; inactive = step out) during a seek operation.
DR0	18	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Drive Select.</b> Active low signal controlled by bit 0 of the Digital Output Register (DOR).
DRATE0	21	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Data Rate.</b> Reflects the value of bit 0 of either Configuration Control Register (CCR) or Data Rate Select Register (DSR), whichever was written to last.
DSKCHG	9	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Disk Change.</b> Indicates that the drive door was opened.
HDSEL	10	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Head Select.</b> Selects which side of the FDD is accessed. Active (low) selects side 1; inactive selects side 0.
INDEX	20	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Index.</b> Indicates the beginning of an FDD track.
MTR0	19	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Motor Select.</b> Active low motor enable signal for drive 0, controlled by bit D4 of the Digital Output Register (DOR).
RDATA	11	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Read Data.</b> Raw serial input data stream read from the FDD.
STEP	16	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Step.</b> Issues pulses to the disk drive at a software programmable rate to move the head during a seek operation.
TRK0	13	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Track 0.</b> Indicates to the controller that the head of the selected floppy disk drive is at track 0.
WDATA	15	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Write Data.</b> Carries out the pre-compensated serial data that is written to the FDD. Pre-compensation is software selectable.

## 1.0 Signal/Pin Connection and Description (Continued)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
WGATE	14	O	OD <sub>12</sub> O <sub>6/12</sub>	V <sub>DD3</sub>	<b>Write Gate.</b> Enables the write circuitry of the selected FDD. WGATE is designed to prevent glitches during power-up and power-down. This prevents writing to the disk when power is cycled.
WP	12	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Write Protected.</b> Indicates that the disk in the selected drive is write protected.

### 1.4.6 Keyboard and Mouse Controller (KBC)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
KBCLK	3	I/O	IN <sub>TS</sub> /OD <sub>14</sub>	V <sub>DD3</sub>	<b>Keyboard Clock.</b> Keyboard clock signal. External pull-up resistor is required for PS/2 compliance. This pin is monitored during V <sub>DD3</sub> power-off for wake-up event detection.
KBDAT	4	I/O	IN <sub>TS</sub> /OD <sub>14</sub>	V <sub>DD3</sub>	<b>Keyboard Data.</b> Keyboard data signal. External pull-up resistor is required for PS/2 compliance. This pin is monitored during V <sub>DD3</sub> power-off for wake-up event detection.
MCLK	1	I/O	IN <sub>TS</sub> /OD <sub>14</sub>	V <sub>DD3</sub>	<b>Mouse Clock.</b> Mouse clock signal. External pull-up resistor is required for PS/2 compliance. This pin is monitored during V <sub>DD3</sub> power-off for wake-up event detection.
MDAT	2	I/O	IN <sub>TS</sub> /OD <sub>14</sub>	V <sub>DD3</sub>	<b>Mouse Data.</b> Mouse data signal. External pull-up resistor is required for PS/2 compliance. This pin is monitored during V <sub>DD3</sub> power-off for wake-up event detection.
KBRST	7	I/O	IN <sub>T</sub> /OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>DD3</sub>	<b>KBD Reset.</b> Keyboard reset (P20) quasi-bidirectional output.
GA20	5	I/O	IN <sub>T</sub> /OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>DD3</sub>	<b>Gate A20.</b> KBC gate A20 (P21) quasi-bidirectional output.

## 1.0 Signal/Pin Connection and Description (Continued)

### 1.4.7 General-Purpose I/O (GPIO)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
GPIOE00	103	I/O	IN <sub>TS</sub> / OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>SB3</sub>	<b>General-Purpose I/O Ports.</b> Each pin is configured independently as input or I/O, with or without static pull-up (and some also with or without static pull-down) and with either open-drain or push-pull output type. These pins have event detection capability to generate a wake-up event or an interrupt. <b>Note: When using GPIOE10-12 on pins 70, 72, 74 check that their respective default functions fit the system usage of those GPIOs. Failure to do so may result in irreversible damage to the chip.</b>
	118		IN <sub>TS</sub> / OD <sub>12</sub> , O <sub>6/12</sub>	V <sub>DD3</sub>	
GPIOE01-06	104-106, 108-109, 111		IN <sub>TS</sub> / OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>SB3</sub>	
	119-121, 124, 126-127			V <sub>DD3</sub>	
GPIOE07	112		IN <sub>TS</sub> / OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>SB3</sub>	
	128		IN <sub>TS</sub> / OD <sub>12</sub> , O <sub>6/12</sub>	V <sub>DD3</sub>	
GPIOE10-13	116, 114, 115, 113		IN <sub>TS2</sub> / OD <sub>6</sub> , O <sub>3/6</sub>	V <sub>SB3</sub>	
	70, 72, 74, 75		IN <sub>TS</sub> / OD <sub>8</sub> , O <sub>4/8</sub>		
GPIOE14, GPIOE16-17	101, 100, 80				
GPIO15	91		IN <sub>TS</sub> / OD <sub>8</sub> , O <sub>4/8</sub>		
GPO11	117	O	OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>SB3</sub>	<b>General-Purpose I/O Port.</b> This pin is configured independently as input or I/O with or without static pull-up and with either open-drain or push-pull output type.
GPO12-13	122, 125			V <sub>DD3</sub>	<b>General-Purpose Output Port.</b> This pin is configured independently as output, with or without static pull-up and with either open-drain or push-pull output type.

### 1.4.8 Health Management (HM)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
SWD	103	I/O	IN <sub>SM</sub> /OD <sub>6</sub>	V <sub>SB3</sub>	<b>SensorPath Data.</b> Bidirectional, SensorPath Data interface signal to LMxx sensor device(s). An internal pull-up for this pin is optional.
HMSCL	88	I/O	IN <sub>SM</sub> /OD <sub>6</sub>	V <sub>SB3</sub>	<b>Health Management SMBus Serial Clock.</b> Serial clock signal. External pull-up resistor to the 3.3V supply is required.
HMSDA	90	I/O	IN <sub>SM</sub> /OD <sub>6</sub>	V <sub>SB3</sub>	<b>Health Management SMBus Serial Data.</b> Serial data signal. External pull-up resistor to the 3.3V supply is required.
FANTACH1-4	111, 112, 104,105	I	IN <sub>TS</sub>	V <sub>DD</sub>	<b>Fan Inputs.</b> Used to feed the fan's tachometer pulse to the Fan Speed Monitor.
FANPWM1-3	106, 108, 109	O	OD <sub>12</sub> , O <sub>6/12</sub>	V <sub>DD</sub>	<b>Fan Outputs.</b> Pulse Width Modulation (PWM) signals, used to control the speed of cooling fans by controlling the voltage supplied to the fan motors.



## 1.0 Signal/Pin Connection and Description (Continued)

### 1.4.9 System Wake-Up Control (SWC)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
GPIOE00-07	103-106, 108-109, 111-112	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Wake-Up Inputs.</b> Generates a wake-up event. These pins have programmable debouncing. When GPIOE functionality of a pin is not required, the internal pull-up resistor must be enabled to allow the pin to be left floating.
	118-121, 124, 126-128			V <sub>DD3</sub>	
GPIOE10-13	116, 114, 115, 113		IN <sub>TS2</sub>	V <sub>SB3</sub>	
	70, 72, 74, 75		IN <sub>TS</sub>		
GPIOE14, GPIOE16-17	101, 100, 80				
R11 R12	32, 118 or 119	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Ring Indicator Wake-Up.</b> When low, generates a wake-up event, indicating that a telephone ring signal was received by the modem.
KBCLK	3	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Keyboard Clock Wake-Up.</b> Generates a wake-up event, when a specific keyboard sequence is detected.
KBDAT	4	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Keyboard Data Wake-Up.</b> Generates a wake-up event, when a specific keyboard sequence is detected.
MCLK	1	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Mouse Clock Wake-Up.</b> Generates a wake-up event, when a specific mouse action is detected.
MDAT	2	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Mouse Data Wake-Up.</b> Generates a wake-up event, when a specific mouse action is detected.
SIOPME	99	O	OD <sub>8</sub> , O <sub>4/8</sub>	V <sub>SB3</sub>	<b>Power Management Event (SCI).</b> Active level indicates that a wake-up event occurred, causing the system to exit its current sleep state. This signal has programmable polarity (default is active low).
SLP_S3, SLP_S5	85, 86	I	IN <sub>TS4</sub>	V <sub>SB3</sub>	<b>Sleep States 3 to 5.</b> Active (low) level indicates the system is in one of the sleep states S3 or S5. These signals are generated by an external ACPI controller.
YLW_LED, GRN_LED	95, 94	O	OD <sub>24</sub>	V <sub>SB3</sub>	<b>Power LEDs.</b> Yellow and green LED drivers. Each indicates the Main power status or blinks under software control.

### 1.4.10 Clocks

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
CLOCKI14	65	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>High-Frequency Clock Input.</b> 14.31818 MHz clock for the on-chip, 48 MHz Clock Generator (for the Legacy modules).

## 1.0 Signal/Pin Connection and Description (Continued)

### 1.4.11 Glue Functions

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
REF5V	70	O	AO	V <sub>SB3</sub>	<b>Main Highest Active Supply, Reference Output.</b> Reference voltage equal to the highest voltage between V <sub>DD5</sub> and V <sub>DD3</sub> . External pull-up resistor to V <sub>DD5</sub> is required.
REF5V_STBY	72	O	AO	V <sub>SB3</sub>	<b>Standby Highest Active Supply, Reference Output.</b> Reference voltage equal to the highest voltage between V <sub>SB5</sub> and V <sub>SB3</sub> . External pull-up resistor to V <sub>SB5</sub> is required.
PS_ON	81	O	OD <sub>6</sub>	V <sub>SB3</sub>	<b>Main Power Supply On/Off Control.</b> Active (low) level turns the main power supply (V <sub>DD</sub> ) on. External pull-up resistor to V <sub>SB5</sub> is required.
PWRGD_PS	82	I	IN <sub>TS4</sub>	V <sub>SB3</sub>	<b>Power Good Signal from the Power Supply.</b> Active level indicates the Main power supply voltage is valid.
PWRGD_3V	84	O	O <sub>3/6</sub>	V <sub>SB3</sub>	<b>Power Good Output.</b> Active level indicates: Main supply voltage is valid and the reset button is not pressed.
CPU_PRESENT	83	I	IN <sub>TS4</sub>	V <sub>SB3</sub>	<b>CPU Present.</b> Active (low) level indicates a processor is currently plugged in.
BKFD_CUT	77	O	OD <sub>6</sub>	V <sub>SB3</sub>	<b>Backfeed-Cut Control.</b> Power distribution control (when switching between main and standby regulators) for system transition into and out of the S3 sleep state. External pull-up resistor to V <sub>DD5</sub> is required.
LATCHED_BF_CUT	79	O	O <sub>14/14</sub>	V <sub>SB3</sub>	<b>Latched Backfeed-Cut.</b> Power distribution control (when switching between main and standby regulators) for system transition into and out of the S5 sleep state.
FPRST	75	I	IN <sub>TS4</sub>	V <sub>SB3</sub>	<b>Front Panel Reset.</b> Active (low) level indicates that the reset button on the front panel is pressed.
V <sub>SB5</sub>	71	I	AI	V <sub>SB3</sub>	<b>Standby 5V Power Supply.</b> Used for Resume Reset generation (Range: 0-5.5V, Backdrive protected).
RSMRST	92	O	O <sub>3/6</sub>	V <sub>SB3</sub>	<b>Resume Reset.</b> Power-Up reset signal based on the V <sub>SB5</sub> supply voltage.
PRIMARY_HD	67	I	IN <sub>TS4</sub>	V <sub>DD3</sub>	<b>Primary Drive.</b> Active (low) level indicates that the primary IDE drive is active.
SECONDARY_HD	68	I	IN <sub>TS4</sub>	V <sub>DD3</sub>	<b>Secondary Drive.</b> Active (low) level indicates that the secondary IDE drive is active.
SCSI	69	I	IN <sub>TS4</sub>	V <sub>DD3</sub>	<b>SCSI Drive.</b> Active (low) level indicates that the SCSI drive is active.
SATA_LED	116	I	IN <sub>TS4</sub>	V <sub>DD3</sub>	<b>Serial ATA Drive.</b> Active (low) level indicates that the S-ATA drive is active.
HD_LED	66	O	OD <sub>12</sub>	V <sub>DD3</sub>	<b>Hard Drive LED.</b> Red LED driver. When low, indicates that at least one drive is active.
CC_DDCSCL	113	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>Chipset Cluster (2.5V or 3.3V) Level DDC Serial Clock.</b> SMBus serial clock signal with 2.5V or 3.3V logic levels for Data Display Channel interface. External pull-up resistor to V <sub>DD3</sub> or 2.5V is required.

## 1.0 Signal/Pin Connection and Description (Continued)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
5V_DDCSCL	114	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>5V Level DDC Serial Clock.</b> SMBus serial clock signal with 5V logic levels for VGA monitor interface. External pull-up resistor to V <sub>DD5</sub> is required.
CC_DDCSDA	115	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>Chipset Cluster (2.5V or 3.3V) Level DDC Serial Data.</b> SMBus serial data signal with 2.5V or 3.3V logic levels for Data Display Channel interface. External pull-up resistor to V <sub>DD3</sub> or 2.5V is required.
5V_DDCSDA	116	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>5V Level DDC Serial Data.</b> SMBus serial data signal with 5V logic levels for VGA monitor interface. External pull-up resistor to V <sub>DD5</sub> is required.
SMB1_SCL	87	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>Bus 1 Serial Clock.</b> Serial clock signal of SMBus 1 (3.3V logic levels). External pull-up resistor to the 3.3V supply is required.
SMB2_SCL	88	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>Bus 2 Serial Clock.</b> Serial clock signal of SMBus 2 (3.3V logic levels). External pull-up resistor to the 3.3V supply is required.
SMB1_SDA	89	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>Bus 1 Serial Data.</b> Serial data signal of SMBus 1 (3.3V logic levels). External pull-up resistor to the 3.3V supply is required.
SMB2_SDA	90	I/O	SW <sub>SM</sub>	V <sub>SB3</sub>	<b>Bus 2 Serial Data.</b> Serial data signal of SMBus 2 (3.3V logic levels). External pull-up resistor to the 3.3V supply is required.
FLOCK	117	O	O <sub>4/8</sub>	V <sub>DD3</sub>	<b>Flash Lock.</b> Write protect control for firmware hub device.

### 1.4.12 Configuration Straps and Testing

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
BADDR	30	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Base Address.</b> Sampled at V <sub>DD</sub> Power-Up reset to determine the base address of the configuration Index-Data register pair, as follows: – No pull-down resistor (default) - 2Eh-2Fh – 10 K $\Omega$ <sup>1</sup> external pull-down resistor - 4Eh-4Fh The external pull-down resistor must be connected to V <sub>SS</sub> .
VsbStrap1	117	I	IN <sub>TS</sub>	V <sub>SB3</sub>	<b>Vsb Strap 1.</b> Reserved strap input function for National use.
VddStrap1	122	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Vdd Strap 1.</b> Reserved strap input function for National use. Will be used for PC8374T.
VddStrap2	125	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>Vdd Strap 2.</b> Reserved strap input function for National use. Will be used for PC8374T.
TRIS	26	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<b>TRI-STATE Device.</b> Sampled at V <sub>DD</sub> Power-Up reset to force the device to float all its output and I/O pins. No pull-down resistor (default) - normal pin operation – 10 K $\Omega$ <sup>1</sup> external pull-down resistor - floating device pins – The external pull-down resistor must be connected to V <sub>SS</sub> . When TRIS is set to 0 (by an external pull-down resistor), TEST must be 1 (left unconnected).

## 1.0 Signal/Pin Connection and Description (Continued)

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
$\overline{\text{TEST}}$	27	I	IN <sub>TS</sub>	V <sub>DD3</sub>	<p><b>XOR Tree Test Mode.</b> Sampled at V<sub>DD</sub> Power-Up reset to force the device pins into a XOR tree configuration.</p> <ul style="list-style-type: none"> <li>– No pull-down resistor (default) - normal device operation</li> <li>– 10 K<math>\Omega</math><sup>1</sup> external pull-down resistor - pins configured as XOR tree.</li> </ul> <p>The external pull-down resistor must be connected to V<sub>SS</sub>. When <math>\overline{\text{TEST}}</math> is set to 0 (by an external pull-down resistor), <math>\overline{\text{TRIS}}</math> must be 1 (left unconnected).</p>
XOR_OUT	30	O	O <sub>4/8</sub>	V <sub>DD3</sub>	<p><b>XOR Tree Output.</b> All the device pins (except power type and analog type pins) are internally connected in a XOR tree structure.</p>

1. Because the strap function is multiplexed with the Serial Port pins, a CMOS transceiver device is recommended for Serial Port functionality; in this case, the value of the external pull-down resistor is 10 K $\Omega$ . If, however, a TTL transceiver device is used, the value of the external pull-down resistor must be 470 $\Omega$ , and since the Serial Port pins are not able to drive this load, the external pull-down resistor must be disconnected t<sub>EPLV</sub> after V<sub>DD3</sub> power-up (see “VDD Power-Up Reset” on page 32).

### 1.4.13 Power and Ground

Signal	Pin(s)	I/O	Buffer Type	Power Well	Description
V <sub>SS</sub>	8, 29, 46, 58, 78, 96, 110	I	GND		<b>Ground.</b> Ground connection for both core logic and I/O buffers, for the Main and Standby power supplies.
V <sub>DD3</sub>	6, 31, 49, 60	I	PWR		<b>Main 3.3V Power Supply.</b> Powers the I/O buffers of the legacy peripherals and the LPC interface.
V <sub>SB3</sub>	76, 93, 107	I	PWR		<b>Standby 3.3V Power Supply.</b> Powers the I/O buffers of the GPIO ports, SWC, Glue Functions, Health Management and the on-chip Core power converter.
V <sub>CORF</sub>	97	I/O	PWR		<b>On-chip Core Power Converter Filter.</b> On-chip Core power converter output. Powers the core logic of all the device modules. An external 1 $\mu$ F ceramic filter capacitor must be connected between this pin and V <sub>SS</sub> .
V <sub>BAT</sub>	98	I	IN <sub>ULR</sub>		<p><b>Battery Power Supply.</b> When V<sub>SB3</sub> is off, this supply provides battery back-up to some of the SWC registers. When the functions powered by V<sub>BAT</sub> are not used, the V<sub>BAT</sub> pin must be connected to V<sub>SB3</sub>.</p> <p>The pin is connected to the internal logic through a series resistor for UL-compliant protection.</p>
V <sub>SB5</sub>	71	I	PWR		<b>Standby 5V Power Supply.</b> Used for Resume Reset generation in the Glue Logic.

## 1.0 Signal/Pin Connection and Description (Continued)

### 1.5 INTERNAL PULL-UP AND PULL-DOWN RESISTORS

The signals listed in Table 4 have internal pull-up (PU) and/or pull-down (PD) resistors. The internal resistors are optional for those signals indicated as "Programmable". See Section 2.3 on page 28 for the values of each resistor type.

**Table 4. Internal Pull-Up and Pull-Down Resistors**

Signal	Pin(s)	Power Well	Type	Comments
<b>Health Management (HM)</b>				
SWD	103	V <sub>SB</sub>	PU <sub>1K25</sub>	Programmable <sup>1</sup>
<b>Parallel Port</b>				
ACK	36	V <sub>DD3</sub>	PU <sub>220</sub>	
AFD_DSTRB	50	V <sub>DD3</sub>	PU <sub>440</sub>	
BUSY_WAIT	35	V <sub>DD3</sub>	PD <sub>120</sub>	
ERR	45	V <sub>DD3</sub>	PU <sub>220</sub>	
INIT	48	V <sub>DD3</sub>	PU <sub>440</sub>	
PE	34	V <sub>DD3</sub>	PU <sub>220</sub> /PD <sub>120</sub>	Programmable
SLCT	33	V <sub>DD3</sub>	PD <sub>120</sub>	
SLIN_ASTRB	47	V <sub>DD3</sub>	PU <sub>440</sub>	
STB_WRITE	51	V <sub>DD3</sub>	PU <sub>440</sub>	
<b>Keyboard and Mouse Controller (KBC)</b>				
KBRST	7	V <sub>DD3</sub>	PU <sub>30</sub>	
GA20	5	V <sub>DD3</sub>	PU <sub>30</sub>	
<b>System Wake-Up Control (SWC)</b>				
SIOPME	99	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>2</sup>
<b>General-Purpose Input/Output (GPIO) Ports</b>				
GPIOE00	103	V <sub>SB</sub>	PU <sub>1K25</sub>	Programmable <sup>3</sup>
	118	V <sub>DD3</sub>	PU <sub>30</sub> /PD <sub>30</sub>	Programmable <sup>4</sup>
GPIOE01-06	104-106, 108, 109, 111	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>1</sup>
	119-121, 124, 126-127	V <sub>DD3</sub>		
GPIOE07	112	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>5</sup>
	128	V <sub>DD3</sub>	PU <sub>30</sub> /PD <sub>30</sub>	Programmable <sup>4</sup>
GPIOE10-12	116, 114, 115	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>6</sup>
	70, 72, 74			
GPIOE13	113	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>6</sup>
	75		PU <sub>90</sub>	Programmable <sup>1</sup>
GPIOE14	101	V <sub>SB3</sub>	PU <sub>30</sub> /PD <sub>30</sub>	Programmable <sup>4</sup>
GPIO15, GPIOE16	91, 100	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>5</sup>
GPIOE17	80	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>1</sup>
GPO11	117	V <sub>SB3</sub>	PU <sub>30</sub>	Programmable <sup>1</sup>

## 1.0 Signal/Pin Connection and Description (Continued)

Table 4. Internal Pull-Up and Pull-Down Resistors (Continued)

Signal	Pin(s)	Power Well	Type	Comments
GPO12-13	122, 125	V <sub>DD3</sub>	PU <sub>30</sub>	Programmable <sup>1</sup>
<b>Glue Functions</b>				
PWRGD_PS	82	V <sub>SB3</sub>	PU <sub>90</sub>	
CPU_PRESENT	83	V <sub>SB3</sub>	PU <sub>90</sub>	
FPRST	75	V <sub>SB3</sub>	PU <sub>90</sub>	
PRIMARY_H $\bar{D}$	67	V <sub>DD3</sub>	PU <sub>90</sub>	
SECONDARY_H $\bar{D}$	68	V <sub>DD3</sub>	PU <sub>90</sub>	
SCSI	69	V <sub>DD3</sub>	PU <sub>90</sub>	
<b>Strap Configuration</b>				
BADDR	30	V <sub>DD3</sub>	PU <sub>30</sub>	Strap <sup>7</sup>
TRIS	26	V <sub>DD3</sub>	PU <sub>30</sub>	Strap <sup>7</sup>
TEST	27	V <sub>DD3</sub>	PU <sub>30</sub>	Strap <sup>7</sup>
VsbStrap1	117	V <sub>SB3</sub>	PU <sub>30</sub>	Strap <sup>8</sup>
VddStrap1	122	V <sub>DD3</sub>	PU <sub>30</sub>	Strap <sup>7</sup>
VddStrap2	125	V <sub>DD3</sub>	PU <sub>30</sub>	Strap <sup>7</sup>

1. Default at reset: enabled.
2. Enabled only when the OD<sub>6</sub> buffer type is selected (OD<sub>6</sub> is the default at reset).
3. Alternate function at reset: enabled.
4. Default at reset: PD enabled.
5. Default at reset: disabled.
6. Alternate function at reset: disabled.
7. Active only during V<sub>DD</sub> Power-Up reset.
8. Active only during V<sub>SB</sub> Power-Up reset.

## 2.0 Device Characteristics

### 2.1 GENERAL DC ELECTRICAL CHARACTERISTICS

#### 2.1.1 Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>DD3</sub>	Main 3V Supply Voltage	3.0	3.3	3.6	V
V <sub>SB3</sub>	Standby 3V Supply Voltage	3.0	3.3	3.6	V
V <sub>BAT</sub>	Battery Backup Supply Voltage	2.4	3.0	3.6	V
T <sub>A</sub>	Operating Temperature	0		+70	°C

#### 2.1.2 Absolute Maximum Ratings

Absolute maximum ratings are values beyond which damage to the device may occur. Unless otherwise specified, all voltages are relative to ground (V<sub>SS</sub>).

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>SUP</sub>	Supply Voltage <sup>1</sup>		−0.5	+4.1	V
V <sub>I</sub>	Input Voltage	All other pins	−0.5	5.5	V
		PCI_CLK, LAD3-0, $\overline{\text{LFRAME}}$ , PCI_RESET, SERIRQ	−0.5	V <sub>DD3</sub> + 0.5	V
V <sub>O</sub>	Output Voltage	All other pins	−0.5	5.5	V
		LAD3-0, $\overline{\text{LDRQ}}$ , SERIRQ	−0.5	V <sub>DD3</sub> + 0.5	V
T <sub>STG</sub>	Storage Temperature		−65	+165	°C
P <sub>D</sub>	Power Dissipation			1	W
T <sub>L</sub>	Lead Temperature Soldering (10 s)			+260	°C
	ESD Tolerance	C <sub>ZAP</sub> = 100 pF R <sub>ZAP</sub> = 1.5 K $\Omega$ <sup>2</sup>	2000		V

1. V<sub>SUP</sub> is V<sub>DD3</sub>, V<sub>SB3</sub>.

2. Value based on test complying with RAI-5-048-RA human body model ESD testing.

#### 2.1.3 Capacitance

Symbol	Parameter	Conditions	Min <sup>2</sup>	Typ <sup>1</sup>	Max <sup>2</sup>	Unit
C <sub>IN</sub>	Input Pin Capacitance			4	5	pF
C <sub>INC</sub>	LPC Clock Input Capacitance	PCI_CLK	5	8	12	pF
C <sub>PCI</sub>	LPC Pin Capacitance	LAD3-0, $\overline{\text{LFRAME}}$ , $\overline{\text{PCI_RESET}}$ , SERIRQ, $\overline{\text{LDRQ}}$		8	10	pF
C <sub>IO</sub>	I/O Pin Capacitance			8	10	pF
C <sub>O</sub>	Output Pin Capacitance			6	8	pF

1. T<sub>A</sub> = 25°C; f = 1 MHz.

2. Not tested. Guaranteed by characterization.

## 2.0 Device Characteristics (Continued)

### 2.1.4 Power Consumption under Recommended Operating Conditions

Symbol	Parameter	Conditions <sup>1</sup>	Typ	Max <sup>2</sup>	Unit
$I_{DD3}$	$V_{DD3}$ Average Supply Current	$V_{IL} = 0.5V$ , $V_{IH} = 2.4V$ , No Load	14	20	mA
$I_{DD3LP}$	$V_{DD3}$ Quiescent Supply Current in Low Power Mode <sup>3</sup>	$V_{IL} = V_{SS}$ , $V_{IH} = V_{DD3}$ , No Load	0.5	0.8	mA
$I_{SB3}$	$V_{SB3}$ Average Supply Current	$V_{IL} = 0.5V$ , $V_{IH} = 2.4V$ , No Load	21	30	mA
$I_{SB3LP}$	$V_{SB3}$ Quiescent Supply Current in Low Power Mode <sup>3</sup>	$V_{IL} = V_{SS}$ , $V_{IH} = V_{SB3}$ , No Load	5	8	mA
$I_{BAT}$	$V_{BAT}$ Battery Supply Current	$V_{DD3}$ , $V_{SB3} = 0V$ , $V_{BAT} = 3V$	TBD	TBD	$\mu A$

1. All parameters specified for  $0^{\circ}C \leq T_A \leq 70^{\circ}C$ ;  $V_{DD3}$  and  $V_{SB3} = 3.3V \pm 10\%$  unless otherwise specified.
2. Not tested. Guaranteed by characterization.
3. All the modules disabled; no LPC bus activity.

### 2.1.5 Voltage Thresholds

Symbol	Parameter <sup>1</sup>	Min <sup>2</sup>	Typ	Max <sup>2</sup>	Unit
$V_{DD3ON}$	$V_{DD3}$ Detected as Power-on	2.3	2.6	2.9	V
$V_{DD3OFF}$	$V_{DD3}$ Detected as Power-off	2.2	2.5	2.8	V
$V_{DD3HY}$	$V_{DD3}$ Hysteresis ( $V_{DD3ON} - V_{DD3OFF}$ )	0.1			V
$V_{SB3ON}$	$V_{SB3}$ Detected as Power-on	2.3	2.6	2.9	V
$V_{SB3OFF}$	$V_{SB3}$ Detected as Power-off	2.2	2.5	2.8	V
$V_{SB3HY}$	$V_{SB3}$ Hysteresis ( $V_{SB3ON} - V_{SB3OFF}$ )	0.1			V
$V_{BATLOW}$	$V_{BAT}$ Detected as "Low"	1.8		2.3	V

1. All parameters specified for  $0^{\circ}C \leq T_A \leq 70^{\circ}C$ .
2. Not tested. Guaranteed by characterization.

## 2.2 DC CHARACTERISTICS OF PINS, BY I/O BUFFER TYPES

The following tables summarize the DC characteristics of all device pins described in Section 1.2 on page 6. The characteristics describe the general I/O buffer types defined in Table 1 on page 6. For exceptions, refer to Section 2.2.13 on page 27. The DC characteristics of the LPC interface meet the *PCI Local Bus Specification (Rev 2.2 December 18, 1998)* for 3.3V DC signaling.

### 2.2.1 Input, TTL Compatible

Symbol:  $IN_T$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IH}$	Input High Voltage		2.0	5.5 <sup>1</sup>	V
$V_{IL}$	Input Low Voltage		-0.5 <sup>1</sup>	0.8	V
$I_{IL}$ <sup>2</sup>	Input Leakage Current	$0 < V_{IN} < V_{SUP}$ <sup>3</sup>		$\pm 1$ <sup>4</sup>	$\mu A$

1. Not tested. Guaranteed by design.
2. Input leakage current includes the output leakage of the bi-directional buffers with TRI-STATE outputs.
3.  $V_{SUP}$  is  $V_{DD3}$  or  $V_{SB3}$  according to the input power well.
4. Maximum 20  $\mu A$  for all pins together (for exceptions, refer to Section 2.2.13 on page 27). Not tested. Guaranteed by characterization.



## 2.0 Device Characteristics (Continued)

### 2.2.2 Input, TTL Compatible, with Schmitt Trigger

Symbol:  $IN_{TS}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IH}$	Input High Voltage		2.0	5.5 <sup>1</sup>	V
$V_{IL}$	Input Low Voltage		-0.5 <sup>1</sup>	0.8	V
$V_{HY}$	Input Hysteresis		250 <sup>2</sup>		mV
$I_{IL}$ <sup>3</sup>	Input Leakage Current	$0 < V_{IN} < V_{SUP}$ <sup>4</sup>		$\pm 1$ <sup>5</sup>	$\mu A$

1. Not tested. Guaranteed by design.

2. Not tested. Guaranteed by characterization.

3. Input leakage current includes the output leakage of the bi-directional buffers with TRI-STATE outputs.

4.  $V_{SUP}$  is  $V_{DD3}$  or  $V_{SB3}$  according to the input power well.

5. Maximum 20  $\mu A$  for all pins together (for exceptions, refer to Section 2.2.13 on page 27.). Not tested. Guaranteed by characterization.

### 2.2.3 Input, TTL Compatible, with 200 mV Schmitt Trigger

Symbol:  $IN_{TS2}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IH}$	Input High Voltage		2.0	5.5 <sup>1</sup>	V
$V_{IL}$	Input Low Voltage		-0.5 <sup>1</sup>	0.8	V
$V_{HY}$	Input Hysteresis		200 <sup>2</sup>		mV
$I_{IL}$ <sup>3</sup>	Input Leakage Current	$0 < V_{IN} < V_{SUP}$ <sup>4</sup>		$\pm 1$ <sup>5</sup>	$\mu A$

1. Not tested. Guaranteed by design.

2. Not tested. Guaranteed by characterization.

3. Input leakage current includes the output leakage of the bi-directional buffers with TRI-STATE outputs.

4.  $V_{SUP}$  is  $V_{DD3}$  or  $V_{SB3}$  according to the input power well.

5. Maximum 20  $\mu A$  for all pins together (for exceptions, refer to Section 2.2.13 on page 27.). Not tested. Guaranteed by characterization.

### 2.2.4 Input, TTL Compatible, with 400 mV Schmitt Trigger

Symbol:  $IN_{TS4}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IH}$	Input High Voltage		2.0	5.5 <sup>1</sup>	V
$V_{IL}$	Input Low Voltage		-0.5 <sup>1</sup>	0.8	V
$V_{HY}$	Input Hysteresis		400 <sup>2</sup>		mV
$I_{IL}$ <sup>3</sup>	Input Leakage Current	$0 < V_{IN} < V_{SUP}$ <sup>4</sup>		$\pm 1$ <sup>5</sup>	$\mu A$

1. Not tested. Guaranteed by design.

2. Not tested. Guaranteed by characterization.

3. Input leakage current includes the output leakage of the bi-directional buffers with TRI-STATE outputs.

4.  $V_{SUP}$  is  $V_{DD3}$  or  $V_{SB3}$  according to the input power well.

5. Maximum 20  $\mu A$  for all pins together (for exceptions, refer to Section 2.2.13 on page 27.). Not tested. Guaranteed by characterization.

## 2.0 Device Characteristics (Continued)

### 2.2.5 Input, PCI 3.3V Compatible

Symbol:  $IN_{PCI}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IH}$	Input High Voltage		$0.5 V_{DD}$	$V_{DD} + 0.5^1$	V
$V_{IL}$	Input Low Voltage		$-0.5^1$	$0.3 V_{DD}$	V
$I_{IL}^2$	Input Leakage Current	$0 < V_{IN} < V_{DD3}$		$\pm 1^3$	$\mu A$

1. Not tested. Guaranteed by design.
2. Input leakage current includes the output leakage of the bi-directional buffers with TRI-STATE outputs.
3. Maximum 20  $\mu A$  for all pins together (for exceptions, refer to Section 2.2.13 on page 27.). Not tested. Guaranteed by characterization.

### 2.2.6 Input, SMBus Compatible

Symbol:  $IN_{SM}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IH}$	Input High Voltage		1.4	$5.5^1$	V
$V_{IL}$	Input Low Voltage		$-0.5^1$	0.8	V
$I_{IL}^2$	Input Leakage Current	$0 < V_{IN} < V_{SB}$		$\pm 1^3$	$\mu A$

1. Not tested. Guaranteed by design.
2. Input leakage current includes the output leakage of the bidirectional buffers with TRI-STATE outputs.
3. Maximum 10  $\mu A$  for all pins together. Not tested. Guaranteed by characterization.

### 2.2.7 Analog Input

Symbol: AI

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{IR}$	Input Voltage Range		0	$5.5^1$	V
$I_{IL}$	Input Leakage Current	$V_{IN} = V_{IR}$		$300^2$	$\mu A$

1. Not tested. Guaranteed by characterization.
2. This buffer type is excluded from the pins for which the total pins leakage of the device is maximum 20  $\mu A$ . Not tested. Guaranteed by characterization.

### 2.2.8 Output, TTL/CMOS Compatible, Push-Pull Buffer

Symbol:  $O_{p/n}$

Output, TTL/CMOS Compatible, rail-to-rail push-pull buffer that is capable of sourcing  $p$  mA and sinking  $n$  mA

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{OH}$	Output High Voltage	$I_{OH} = -p$ mA	2.4		V
		$I_{OH} = -50$ $\mu A$	$V_{SUP} - 0.2^1$		V
$V_{OL}$	Output Low Voltage	$I_{OL} = n$ mA		0.4	V
		$I_{OL} = 50$ $\mu A$		0.2	V

1.  $V_{SUP}$  is  $V_{DD3}$  or  $V_{SB3}$  according to the output power well.

## 2.0 Device Characteristics (Continued)

### 2.2.9 Output, TTL/CMOS Compatible, Open-Drain Buffer

Symbol:  $OD_n$

Output, TTL/CMOS-compatible open-drain output buffer capable of sinking  $n$  mA. Output from these signals is open-drain and is never forced high.

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{OL}$	Output Low Voltage	$I_{OL} = n$ mA		0.4	V
		$I_{OL} = 50$ $\mu$ A		0.2	V

### 2.2.10 Output, PCI 3.3V Compatible

Symbol:  $O_{PCI}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{OH}$	Output High Voltage	$I_{out} = -500$ $\mu$ A	$0.9 V_{DD3}$		V
$V_{OL}$	Output Low Voltage	$I_{out} = 1500$ $\mu$ A		$0.1 V_{DD3}$	V

### 2.2.11 Analog Output

Symbol: AO

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{OR}$	Output Voltage Range		0	$5.5^1$	V
$V_{OD}$	Output Drive Voltage	$I_{out} = -3.6$ mA	$V_{SUP}^2 - 150$ mV		
$I_{OL}$	Output Leakage Current	$V_{OUT} = V_{OR}$ , $V_{SUP} < V_{OUT}$		$20^3$	$\mu$ A

1. Not tested. Guaranteed by characterization.

2.  $V_{SUP}$  is  $V_{DD3}$  or  $V_{SB3}$  according to the pin power well.

3. This buffer type is excluded from the pins for which the total pins leakage of the device is maximum 10  $\mu$ A.

Not tested. Guaranteed by characterization.

### 2.2.12 Input/Output Switch, SMBus Compatible

Symbol:  $SW_{SM}$

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DRP}$	Pin-to-Pin Voltage Drop	$I_{SW} = \pm 3$ mA, Switch Closed		$150^1$	mV
$V_{ISC}$	Input Voltage for Switch Closed	$I_{SW} = \pm 3$ mA	$1.5^1$		V
$V_{ISO}$	Input Voltage for Switch Open	$I_{SW} = \pm 20$ $\mu$ A		2.25	V
$I_{IL}$	Input Leakage Current	$V_{ISO} < V_{IN} < 5.5$ V		$\pm 20^1$	$\mu$ A

1. Not tested. Guaranteed by characterization.

### 2.2.13 Exceptions

1. All pins are 5V tolerant except for the pins with PCI ( $IN_{PCI}$ ,  $O_{PCI}$ ) buffer types.
2. All pins are back-drive protected except for the output pins with PCI ( $O_{PCI}$ ) buffer types.
3. The following pins are excluded from the requirement of total pins leakage maximum 10  $\mu$ A:  $V_{SB5}$ , REF5V, REF5V\_STBY, CC\_DDCSCL, 5V\_DDCSCL, CC\_DDCSDA, 5V\_DDCSDA, SMB1\_SCL, SMB1\_SDA, SMB2\_SCL, SMB2\_SDA.
4. The following pins have an internal static pull-up resistor (when enabled) and therefore may have leakage current from

## 2.0 Device Characteristics (Continued)

$V_{SUP}$  (when  $V_{IN} = 0$ ):  $\overline{SWD}$ ,  $\overline{ACK}$ ,  $\overline{AFD\_DSTRB}$ ,  $\overline{ERR}$ ,  $\overline{INIT}$ ,  $PE$ ,  $\overline{SLIN\_ASTRB}$ ,  $\overline{STB\_WRITE}$ ,  $\overline{KBRST}$ ,  $GA20$ ,  $\overline{SIOPME}$ ,  $\overline{GPIOE00-07}$ ,  $\overline{GPIOE10-17}$ ,  $\overline{GPO11-13}$   $PWRGD\_PS$ ,  $CPU\_PRESENT$ ,  $\overline{FPRST}$ ,  $\overline{PRIMARY\_HD}$ ,  $\overline{SECONDARY\_HD}$ ,  $\overline{SCSI}$ .

- The following pins have an internal static pull-down resistor (when enabled) and therefore may have leakage current to  $V_{SS}$  (when  $V_{IN} = V_{SUP}$ ):  $\overline{BUSY\_WAIT}$ ,  $PE$  and  $SLCT$ ,  $\overline{GPIOE14}$ ,  $\overline{GPIOE00}$  (on pin 118),  $\overline{GPIOE07}$  (on pin 128),.
- The following strap pins have an internal static pull-up resistor enabled during Power-Up reset and therefore may have leakage current to  $V_{SUP}$  (when  $V_{IN} = 0$ ):  $\overline{BADDR}$ ,  $\overline{TRIS}$ ,  $\overline{TEST}$ ,  $VsbStrap1$ ,  $VddStrap1$ ,  $VddStrap2$ .
- When  $V_{DD3} = 0V$ , the following pins present a DC load to  $V_{SS}$  of 30 K $\Omega$  minimum (not tested, guaranteed by design) for a pin voltage of 0V to 3.6V:  $\overline{CTS1}$ ,  $\overline{CTS2}$ ,  $\overline{DCD1}$ ,  $\overline{DCD2}$ ,  $\overline{DSR1}$ ,  $\overline{DSR2}$ ,  $\overline{DTR\_BOUT1}$ ,  $\overline{DTR\_BOUT2}$ ,  $\overline{RI1}$ ,  $\overline{RI2}$ ,  $\overline{RTS1}$ ,  $\overline{RTS2}$ ,  $\overline{SIN1}$ ,  $\overline{SIN2}$ ,  $\overline{SOUT1}$ ,  $\overline{SOUT2}$ .
- Output from  $SLCT$ ,  $\overline{BUSY\_WAIT}$  (and  $PE$  if bit 2 of PP Config0 register is 0) is open-drain in all SPP modes except in SPP-Compatible mode when the setup mode is ECP-based FIFO and bit 4 of the Control2 parallel port register is 1. Otherwise, output from these signals is level 2. External 4.7 K $\Omega$  pull-up resistors should be used.
- Output from  $\overline{ACK}$ ,  $\overline{ERR}$  (and  $PE$  if bit 2 of PP Config0 register is set to 1) is open-drain in all SPP modes except in SPP-Compatible mode when the setup mode is ECP-based FIFO and bit 4 of the Control2 parallel port register is set to 1. Otherwise, output from these signals is level 2. External 4.7 K $\Omega$  pull-up resistors should be used.
- Output from  $\overline{STB}$ ,  $\overline{AFD}$ ,  $\overline{INIT}$  and  $\overline{SLIN}$  is open-drain in all SPP modes, except in SPP-Compatible mode when the setup mode is ECP-based (FIFO). Otherwise, output from these signals is level 2. External 4.7 K $\Omega$  pull-up resistors should be used.
- $I_{OH}$  is valid for a GPIO pin only when it is not configured as open-drain.
- In XOR Tree mode, the buffer type of the input pins participating in the XOR Tree (see Section TBD) is  $IN_T$  (Input, TTL compatible), regardless of the buffer type of these pins in normal device operation mode (see Section 1.4 on page 12)

### 2.2.14 Terminology

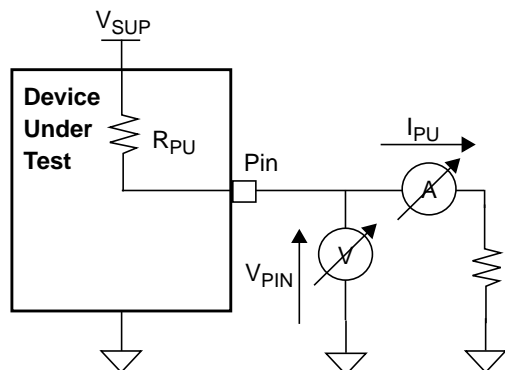
**Back-Drive Protection.** A pin that is back-drive protected does not sink current into the supply when an input voltage higher than the supply, but below the pin's maximum input voltage, is applied to the pin. This is true even when the supply is inactive. Note that active pull-up resistors and active output buffers are typically not back-drive protected.

**5-Volt Tolerance.** An input signal that is 5V tolerant can operate with input voltage of up to 5V even though the supply to the device is only 3.3V. The actual maximum input voltage allowed to be supplied to the pin is indicated by the maximum high voltage allowed for the input buffer. Note that some pins have multiple buffers, not all of which are 5V tolerant. In such cases, there is a note that indicates at what conditions a 5V input may be applied to the pin; if there is no note, the low maximum voltage among the buffers is the maximum voltage allowed for the pin.

## 2.3 INTERNAL RESISTORS

### DC Test Conditions

#### Pull-Up Resistor Test Circuit



#### Pull-Down Resistor Test Circuit

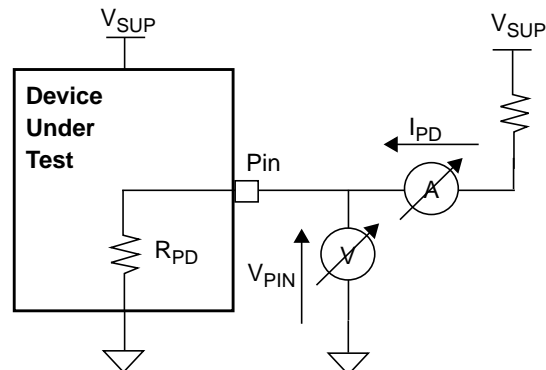


Figure 1. Internal Resistor Test Conditions,  $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{SUP} = 3.3V$

## 2.0 Device Characteristics (Continued)

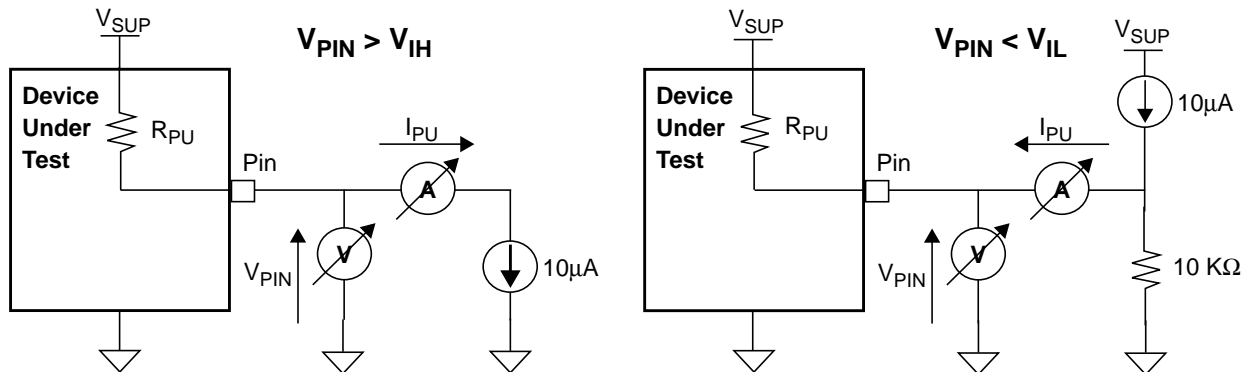


Figure 2. Internal Pull-Down Resistor for Straps,  $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{\text{SUP}} = 3.3\text{V}$

Notes for Figures 1 and 2:

- $V_{\text{SUP}}$  is  $V_{\text{DD3}}$  or  $V_{\text{SB3}}$  according to the pin power well.
- The equivalent resistance of the pull-up resistor is calculated by  $R_{\text{PU}} = (V_{\text{SUP}} - V_{\text{PIN}}) / I_{\text{PU}}$ .
- The equivalent resistance of the pull-down resistor is calculated by  $R_{\text{PD}} = V_{\text{PIN}} / I_{\text{PD}}$ .

### 2.3.1 Pull-Up Resistor

Symbol:  $\text{PU}_{nn}$

Symbol	Parameter	Conditions <sup>1</sup>	Min <sup>2</sup>	Typical	Max <sup>2</sup>	Unit
$R_{\text{PU}}$	Pull-up equivalent resistance	$V_{\text{PIN}} = 0\text{V}$	$nn - 30\%$	$nn$	$nn + 30\%$	$\text{K}\Omega$
		$V_{\text{PIN}} = 0.8 V_{\text{SUP}}^3$			$nn - 38\%$	$\text{K}\Omega$
		$V_{\text{PIN}} = 0.17 V_{\text{SUP}}^3$	$nn - 35\%$			$\text{K}\Omega$

1.  $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{\text{SUP}} = 3.3\text{V}$ .

2. Not tested. Guaranteed by characterization.

3. For strap pins only.

### 2.3.2 Pull-Down Resistor

Symbol:  $\text{PD}_{nn}$

Symbol	Parameter	Conditions <sup>1</sup>	Min <sup>2</sup>	Typical	Max <sup>2</sup>	Unit
$R_{\text{PD}}$	Pull-down equivalent resistance	$V_{\text{PIN}} = V_{\text{SUP}}$	$nn - 30\%$	$nn$	$nn + 30\%$	$\text{K}\Omega$

1.  $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{\text{SUP}} = 3.3\text{V}$ .

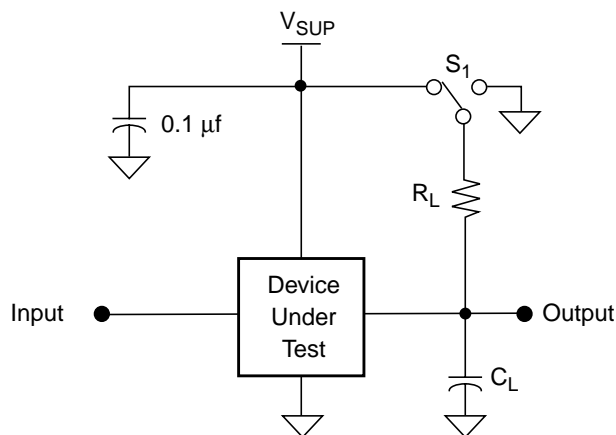
2. Not tested. Guaranteed by characterization.

## 2.0 Device Characteristics (Continued)

### 2.4 AC ELECTRICAL CHARACTERISTICS

#### 2.4.1 AC Test Conditions

##### Load Circuit



##### AC Testing Input, Output Waveform

(unless otherwise specified)

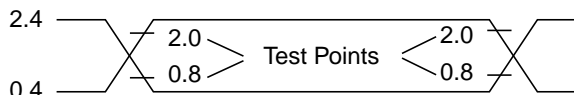


Figure 3. AC Test Conditions,  $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{SUP} = 3.3\text{V} \pm 10\%$

Notes:

- $V_{SUP}$  is either  $V_{DD3}$  or  $V_{SB3}$ , according to the pin power well.
- $C_L = 50$  pF for all output pins except the following pin groups:
  - $C_L = 100$  pF for Serial Port 1 and 2 pins (see Section 1.4.2 on page 12), Parallel Port pins (see Section 1.4.4) and Floppy Disk Controller pins (see Section 1.4.5)
  - $C_L = 40$  pF for IDE\_RSTDRV pin
  - $C_L = 400$  pF for SMBus pins (see "SMBus Voltage Translation and Isolation Timing" on page 45)
 These values include both jig and oscilloscope capacitance.
- $S_1 = \text{Open}$  – for push-pull output pins.  
 $S_1 = V_{SUP}$  – for high-impedance to active low and active low to high impedance transition measurements  
 $S_1 = \text{GND}$  – for high-impedance to active high and active high to high impedance transition measurements  
 $R_L = 1.0$  K $\Omega$  – for all the pins
- For the FDC open-drain interface pins,  $S_1 = V_{DD3}$  and  $R_L = 150\Omega$ .

#### 2.4.2 Reset Timing

##### $V_{SB}$ Power-Up Reset

Symbol	Figure	Description	Reference Conditions		Min <sup>1</sup>	Max <sup>1</sup>
$t_{IRST}$	4	Internal Power-Up Reset Time	$V_{SB3}$ power-up to end of internal reset	Ended by 32 KHz Clock Domain		$t_{32KW} + t_{32KVAL}^2 + 17 \cdot t_{CP}$
	5			Ended by PCI_RESET		$t_{LRST}$
$t_{LRST}$	5	PCI_RESET active time	$V_{SB3}$ power-up to end of $\overline{\text{PCI\_RESET}}$		10 ms	
$t_{IPLV}$	5	Internal VsbStrap1 strap pull-up resistor, valid time <sup>3</sup>	Before end of internal reset		$t_{IRST}$	
$t_{EPLV}$	5	External VsbStrap1 strap pull-down resistor, valid time	Before end of internal reset		$t_{IRST}$	

1. Not tested. Guaranteed by design.

2.  $t_{32KW} + t_{32KVAL}$  from  $V_{SB3}$  power-up to 32 KHz domain toggling; see "Low-Frequency Clock Timing" on page 34.

3. Active only during  $V_{SB3}$  Power-Up reset.

## 2.0 Device Characteristics (Continued)

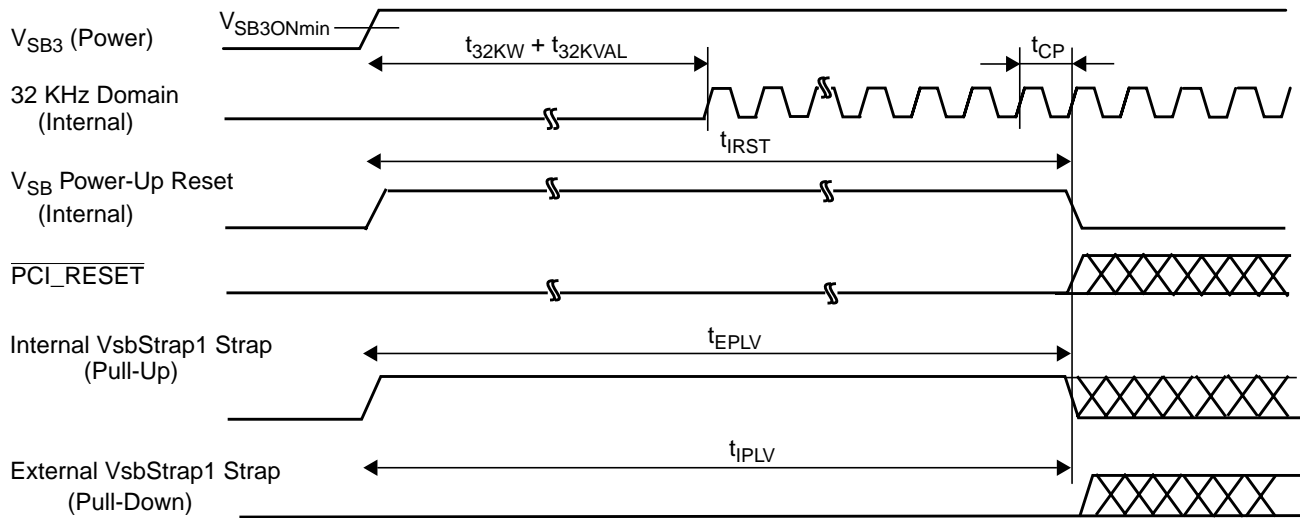


Figure 4. Internal V<sub>SB</sub> Power-Up Reset - Ended by 32 KHz Clock

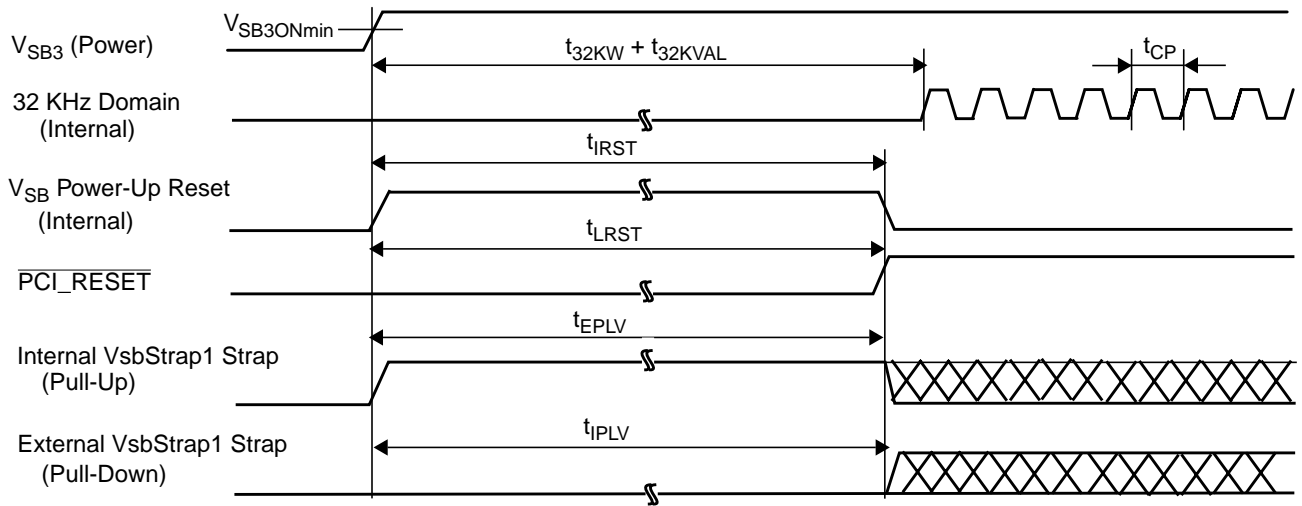


Figure 5. Internal V<sub>SB</sub> Power-Up Reset - Ended by PCI\_RESET

2.0 Device Characteristics (Continued)

V<sub>DD</sub> Power-Up Reset

Symbol	Figure	Description	Reference Conditions	Min <sup>1</sup>	Max <sup>1</sup>
t <sub>IRST</sub>	6	Internal Power-Up reset time	V <sub>DD3</sub> power-up to end of internal reset		t <sub>LRST</sub>
t <sub>LRST</sub>	6	PCI_RESET active time	V <sub>DD3</sub> power-up to end of PCI_RESET	10 ms	2.5 s
t <sub>IPLV</sub>	6	Internal strap pull-up resistor, valid time <sup>2</sup>	Before end of internal reset	t <sub>IRST</sub>	
t <sub>EPLV</sub>	6	External strap pull-down resistor, valid time	Before end of internal reset	t <sub>IRST</sub>	

1. Not tested. Guaranteed by design.  
2. Active only during V<sub>DD3</sub> Power-Up reset.

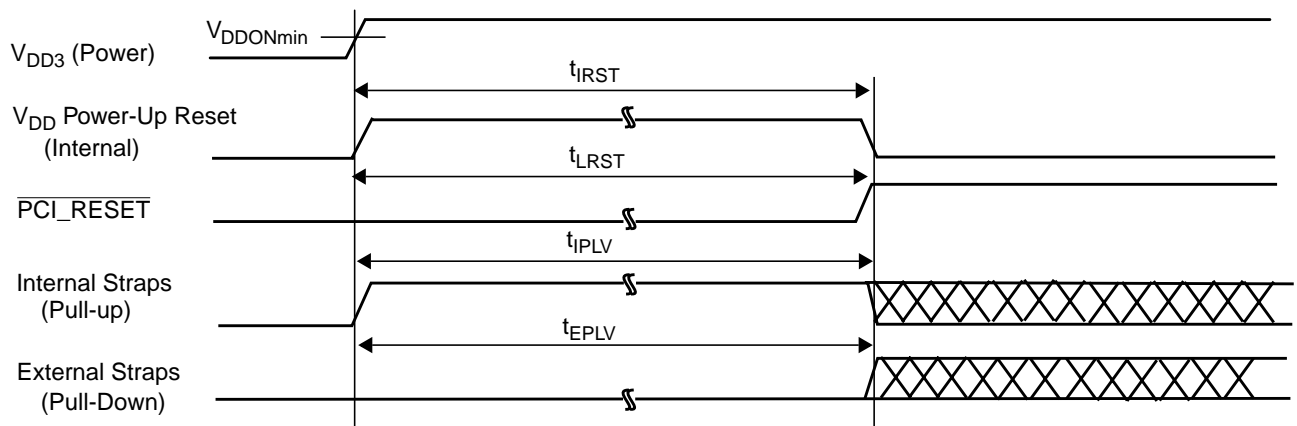


Figure 6. Internal V<sub>DD</sub> Power-Up Reset

Hardware Reset

Symbol	Figure	Description	Reference Conditions	Min	Max
t <sub>WRST</sub>	7	PCI_RESET pulse width		100 ns	

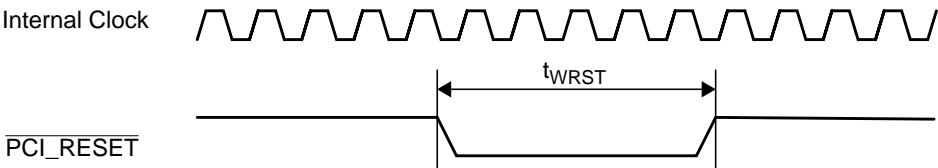


Figure 7. Hardware Reset



## 2.0 Device Characteristics (Continued)

### 2.4.3 Clock Timing

#### High-Frequency Clock Timing

Symbol	Figure	Clock Input Parameters	Reference Conditions	CLOCKI14			Units
				Min	Typ	Max	
$t_{CH}$	8	Clock High Pulse Width <sup>1</sup>		29.5			ns
$t_{CL}$	8	Clock Low Pulse Width <sup>1</sup>		29.5			ns
$t_{CP}$	8	Clock Period <sup>1</sup> (50%-50%)		69.14	69.84	70.54	ns
$F_{CK}$	–	Clock Frequency		$F_{CKTYP} - 1\%$	14.31818	$F_{CKTYP} + 1\%$	MHz
$t_{CR}$	8	Clock Rise Time <sup>1</sup> (20%-80%)				$5^2$	ns
$t_{CF}$	8	Clock Fall Time <sup>1</sup> (80%-20%)				$5^2$	ns
$t_{CE}$	9	Clock Generator Enable	RE PCI_RESET to Clock Generator enabled			80	$\mu$ s

1. Not tested. Guaranteed by design.

2. Recommended value

Sym.	Fig.	Internal Clock Parameter	Reference Conditions	INT48M			Units
				Min	Typ	Max	
$t_{CP}$	8	Clock Period <sup>1</sup> (50%-50%)			20.83		ns
$F_{CK}$	–	Clock Frequency			48		MHz
$t_{48MD}$	9	Clock Wake-Up Time <sup>1</sup>	After Clock Generator enabled			500	$\mu$ s

1. Not tested. Guaranteed by characterization.

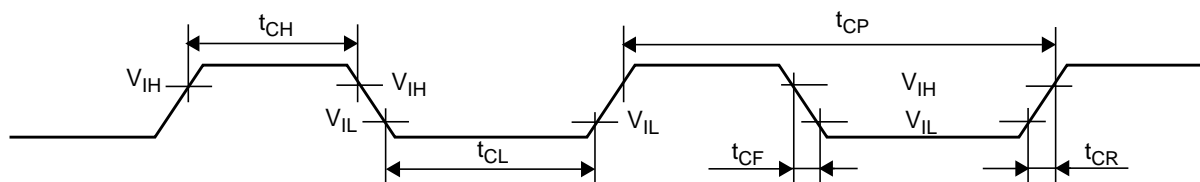


Figure 8. High-Frequency Clock Waveform Timing

## 2.0 Device Characteristics (Continued)

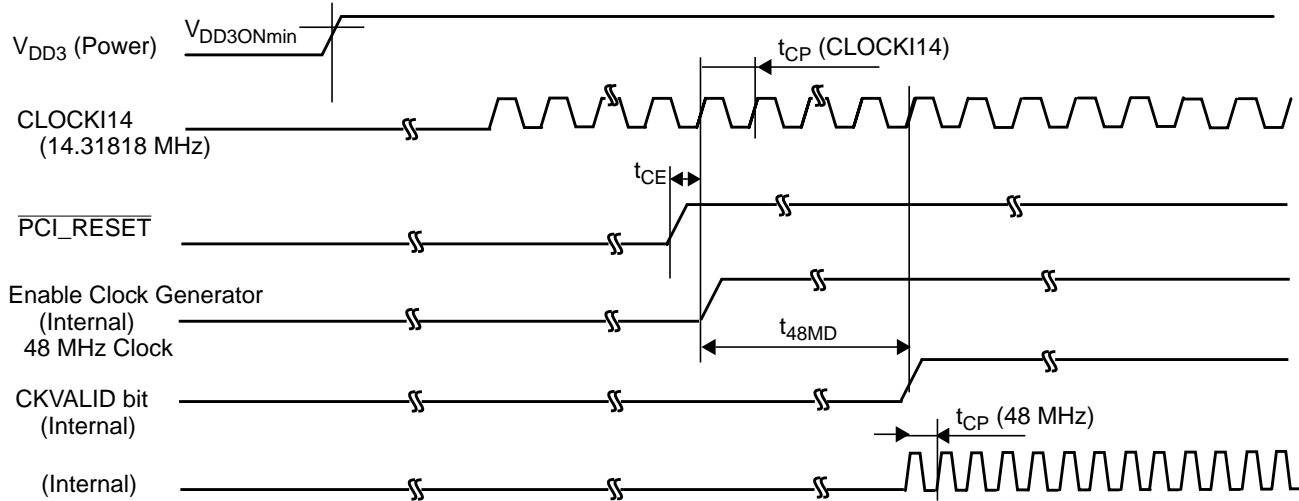


Figure 9. CLOCKI14 and Internal 48 MHz Clock Timing

### Low-Frequency Clock Timing

Symbol	Figure	Internal Clock Parameters	Reference Conditions	INT32K			Units
				Min	Typ	Max	
$t_{CP}$	10	Clock Period <sup>1</sup> (50%-50%)	After $V_{SB3}$ power-up	21.3623	30.517578	39.6728	$\mu s$
$t_{CPL}$	10	Clock Period <sup>1</sup> (50%-50%)	After $CLOCKI14$ valid	30.2124	30.517578	30.8227	
			When $V_{DD3}$ does not exist	27.465820	30.517578	33.569336	
$F_{CK}$	–	Clock Frequency	After $V_{SB3}$ power-up	$F_{32TYP} - 30\%$	32.768 ( $F_{32TYP}$ )	$F_{32TYP} + 30\%$	KHz
$F_{CKL}$		Clock Frequency	After $CLOCKI14$ valid	$F_{32TYP} - 1\%$	32.768 ( $F_{32TYP}$ )	$F_{32TYP} + 1\%$	
		Clock Frequency	When $V_{DD3}$ does not exist	$F_{32TYP} - 10\%$	32.768 ( $F_{32TYP}$ )	$F_{32TYP} + 10\%$	
$t_{32KW}$	10	Clock wake-up time <sup>1</sup>	$V_{SB3}$ stable to clock start toggling			5	ms
$t_{32KVAL}$	10	Clock valid time <sup>1</sup>	Clock start toggling to clock valid			1	ms

1. Not tested. Guaranteed by characterization.

## 2.0 Device Characteristics (Continued)

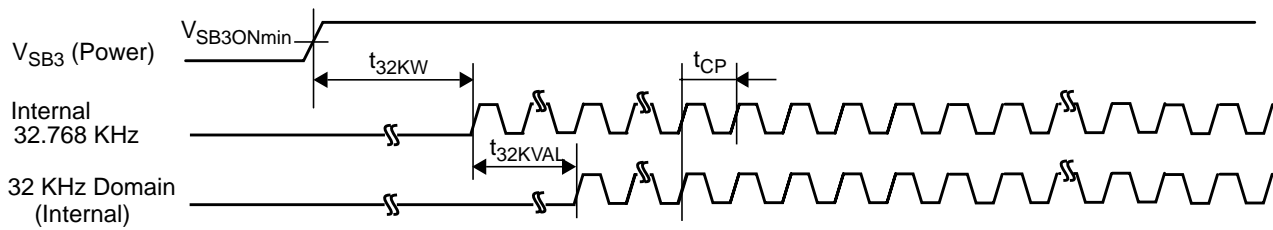


Figure 10. Internal 32 KHz (INT32K) Timing

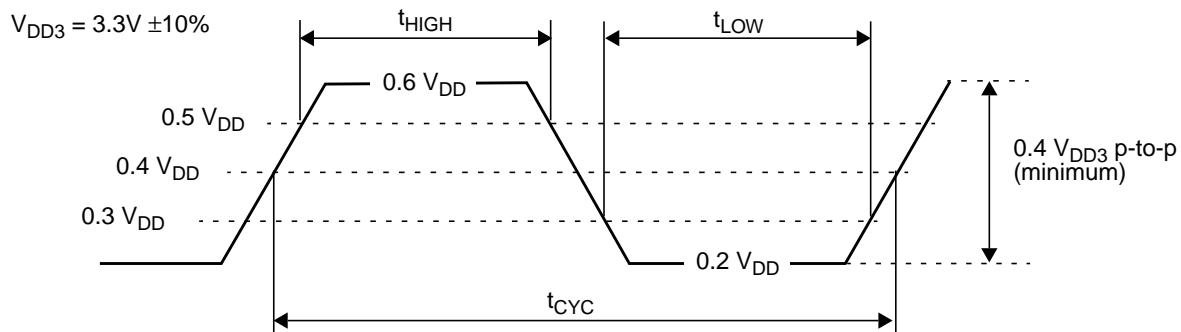
### 2.4.4 LPC Interface Timing

The AC characteristics of the LPC interface meet the PCI Local Bus Specification (Rev 2.2 December 18, 1998) for 3.3V DC signaling.

#### PCI\_CLK and $\overline{\text{PCI\_RESET}}$

Symbol	Parameter	Min	Max	Units
$t_{\text{CYC}}^1$	PCI_CLK Cycle Time	30		ns
$t_{\text{HIGH}}$	PCI_CLK High Time <sup>2</sup>	11		ns
$t_{\text{LOW}}$	PCI_CLK Low Time <sup>2</sup>	11		ns
–	PCI_CLK Slew Rate <sup>2,3</sup>	1	4	V/ns
–	$\overline{\text{PCI\_RESET}}$ Slew Rate <sup>2,4</sup>	50		mV/ns

1. The PCI may have any clock frequency between nominal DC and 33 MHz. Device operational parameters at frequencies under 16 MHz are guaranteed by design rather than by testing. The clock frequency may be changed at any time during the operation of the system as long as the clock edges remain “clean” (monotonic) and the minimum cycle high and low times are not violated. The clock may only be stopped in a low state.
2. Not tested. Guaranteed by characterization.
3. Rise and fall times are specified in terms of the edge rate measured in V/ns. This slew rate must be met across the minimum peak-to-peak portion of the clock wavering ( $0.2 \cdot V_{\text{DD3}}$  to  $0.6 \cdot V_{\text{DD3}}$ ) as shown below.
4. The minimum  $\overline{\text{PCI\_RESET}}$  slew rate applies only to the rising (de-assertion) edge of the reset signal and ensures that system noise cannot make an otherwise monotonic signal appear to bounce in the switching range.



## 2.0 Device Characteristics (Continued)

### LPC Signals

Symbol	Figure	Description	Reference Conditions	Min	Max	Unit
$t_{VAL}$	Outputs	Output Valid Delay	After RE of CLK	2	11	ns
$t_{ON}$	Outputs	Float to Active Delay	After RE of CLK	2		ns
$t_{OFF}$	Outputs	Active to Float Delay	After RE of CLK		28	ns
$t_{SU}$	Inputs	Input Setup Time	Before RE of CLK	7		ns
$t_{HL}$	Inputs	Input Hold Time	After RE of CLK	0		ns
$t_{PDR}$	Reset Outputs	Rise Propagation Delay	From RE of $\overline{PCI\_RESET}$ to RE of $PCIRST\_OUT$ , $PCIRST\_OUT2$		30	ns
$t_R$	Reset Outputs	Rise Time	$PCIRST\_OUT$ , $PCIRST\_OUT2$		50	ns
$t_{PDF}$	Reset Outputs	Fall Propagation Delay	From FE of $\overline{PCI\_RESET}$ to FE of $IDE\_RSTDRV$		20	ns
$t_F$	Reset Outputs	Fall Time	$IDE\_RSTDRV$		15	ns

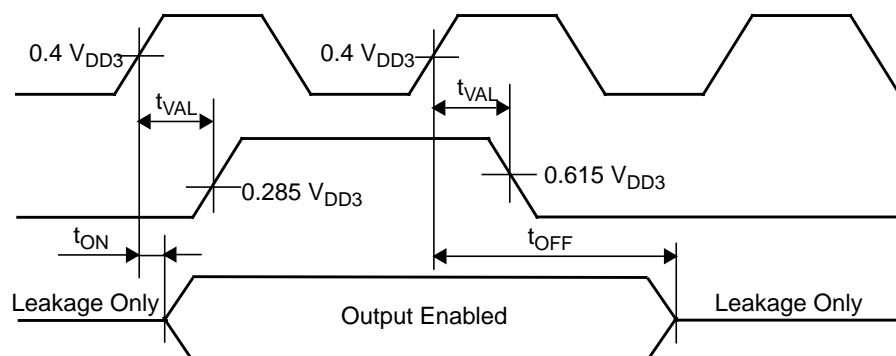
#### Outputs

$V_{DD3} = 3.3V \pm 10\%$

PCI\_CLK

LAD3–LAD0,  
LDRQ, SERIRQ

LAD3–LAD0,  
SERIRQ

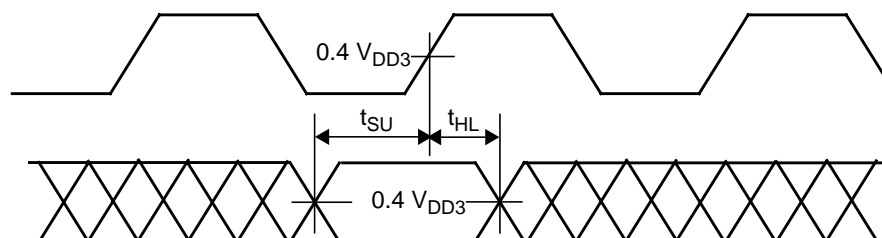


#### Inputs

$V_{DD3} = 3.3V \pm 10\%$

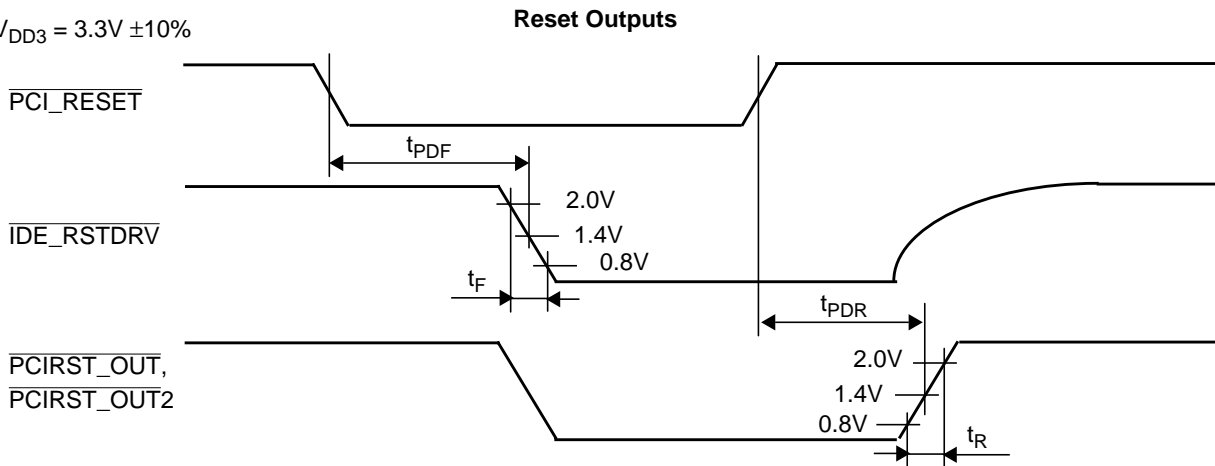
PCI\_CLK

LAD3–LAD0,  $\overline{LFRAME}$   
 $\overline{PCI\_RESET}$ , SERIRQ



## 2.0 Device Characteristics (Continued)

$V_{DD3} = 3.3V \pm 10\%$

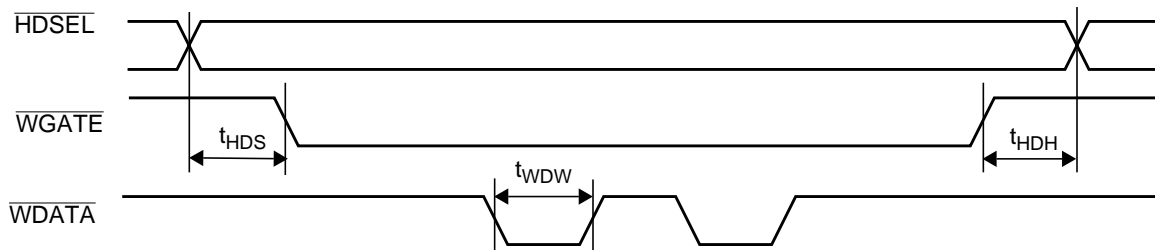


### 2.4.5 FDC Timing

#### FDC Write Data Timing

Symbol	Parameter	Min	Max	Unit
$t_{HDH}$	$\overline{HDSEL}$ Hold from $\overline{WGATE}$ Inactive <sup>1</sup>	100		$\mu s$
$t_{HDS}$	$\overline{HDSEL}$ Setup to $\overline{WGATE}$ Active <sup>1</sup>	100		$\mu s$
$t_{WDW}$	Write Data Pulse Width <sup>1</sup>	See $t_{DRP}$ , $t_{ICP}$ and $t_{WDW}$ values in table below		

1. Not tested. Guaranteed by design.



$t_{DRP}$   $t_{ICP}$   $t_{WDW}$  Values

Data Rate	$t_{DRP}$	$t_{ICP}$	$t_{ICP}$ Nominal	$t_{WDW}$	$t_{WDW}$ Minimum	Unit
1 Mbps	1000	$6 \times t_{CP}$ <sup>1</sup>	125	$2 \times t_{ICP}$	250	ns
500 Kbps	2000	$6 \times t_{CP}$ <sup>1</sup>	125	$2 \times t_{ICP}$	250	ns
300 Kbps	3333	$10 \times t_{CP}$ <sup>1</sup>	208	$2 \times t_{ICP}$	375	ns
250 Kbps	4000	$12 \times t_{CP}$ <sup>1</sup>	250	$2 \times t_{ICP}$	500	ns

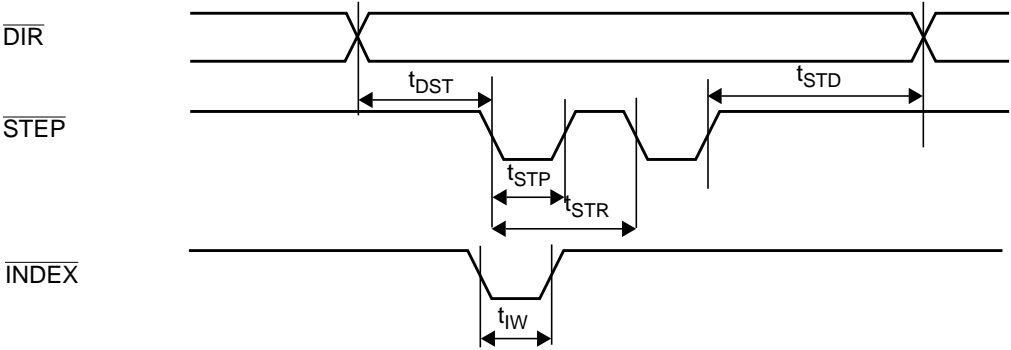
1.  $t_{CP}$  is the clock period defined for CLOCK1 in "Clock Timing" on page 33.

2.0 Device Characteristics (Continued)

FDC Drive Control Timing

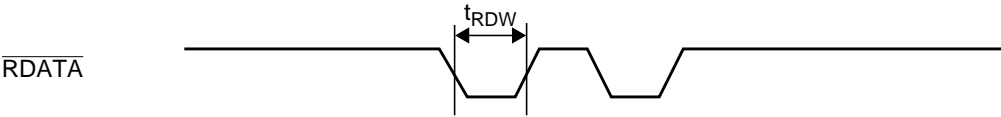
Symbol	Parameter	Min	Max	Unit
$t_{DST}$	$\overline{DIR}$ Setup to $\overline{STEP}$ Active <sup>1</sup>	6		$\mu s$
$t_{IW}$	Index Pulse Width	100		ns
$t_{STD}$	$\overline{DIR}$ Hold from $\overline{STEP}$ Inactive	$t_{STR}$		ms
$t_{STP}$	$\overline{STEP}$ Active High Pulse Width <sup>1</sup>	8		$\mu s$
$t_{STR}$	$\overline{STEP}$ Rate Time <sup>1</sup>	0.5		ms

1. Not tested. Guaranteed by design.



FDC Read Data Timing

Symbol	Parameter	Min	Max	Unit
$t_{RDW}$	Read Data Pulse Width	50		ns

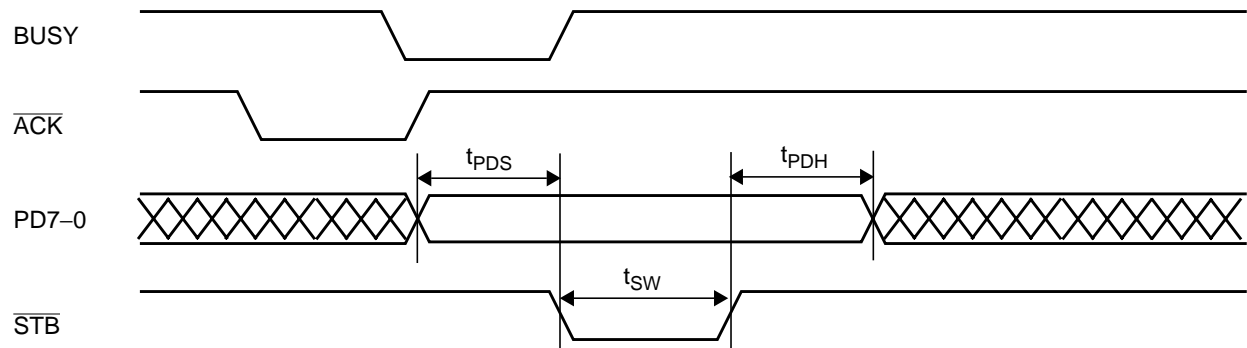


## 2.0 Device Characteristics (Continued)

### 2.4.6 Parallel Port Timing

#### Standard Parallel Port Timing

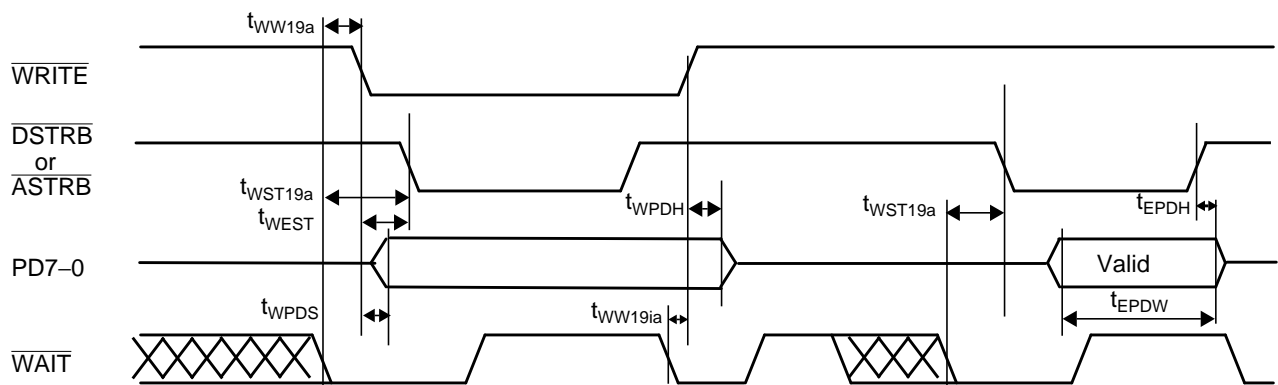
Symbol	Parameter	Conditions	Min	Max	Unit
$t_{PDH}$	Port Data Hold	SPP Mode 0 and Mode 1, ECP Mode 0 and Mode1: system dependent; ECP Mode 2: device dependent.	750		ns
$t_{PDS}$	Port Data Setup	SPP Mode 0 and Mode 1, ECP Mode 0 and Mode1: system dependent; ECP Mode 2: device dependent.	750		ns
$t_{SW}$	Strobe Width	SPP Mode 0 and Mode 1, ECP Mode 0 and Mode1: system dependent; ECP Mode 2: device dependent.	750		ns



#### Enhanced Parallel Port Timing

Symbol	Parameter	Min	Max	EPP 1.7 <sup>1</sup>	EPP 1.9 <sup>1</sup>	Unit
$t_{WW19a}$	WRITE Active from WAIT Low		45		✓	ns
$t_{WW19ia}$	WRITE Inactive from WAIT Low		45		✓	ns
$t_{WST19a}$	DSTRB or ASTRB Active from WAIT Low		65		✓	ns
$t_{WEST}$	DSTRB or ASTRB Active after WRITE Active	10		✓	✓	ns
$t_{WPDH}$	PD7-0 Hold after WRITE Inactive	0		✓	✓	ns
$t_{WPDS}$	PD7-0 Valid after WRITE Active		15	✓	✓	ns
$t_{EPDW}$	PD7-0 Valid Width	80		✓	✓	ns
$t_{EPDH}$	PD7-0 Hold after DSTRB or ASTRB Inactive	0		✓	✓	ns

1. Also in ECP Mode 4



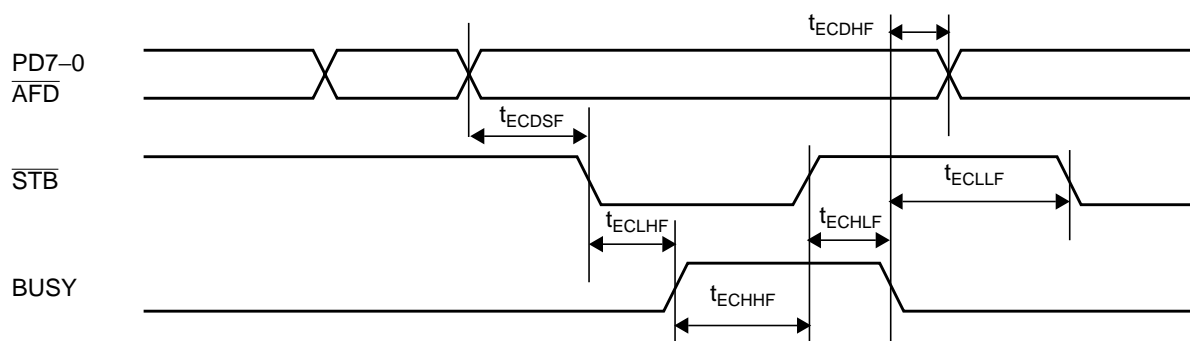
## 2.0 Device Characteristics (Continued)

### Extended Capabilities Port (ECP) Timing

#### Forward Mode

Symbol	Parameter	Min	Max	Unit
$t_{ECDSF}$	Data Setup before $\overline{STB}$ Active	0		ns
$t_{ECDHF}$	Data Hold after $BUSY$ Inactive	0		ns
$t_{ECLHF}$	$BUSY$ Active after $\overline{STB}$ Active	75		ns
$t_{ECHHF}$	$\overline{STB}$ Inactive after $BUSY$ Active <sup>1</sup>	0	1	s
$t_{ECHLF}$	$BUSY$ Inactive after $\overline{STB}$ Active <sup>1</sup>	0	35	ms
$t_{ECLLF}$	$\overline{STB}$ Active after $BUSY$ Inactive	0		ns

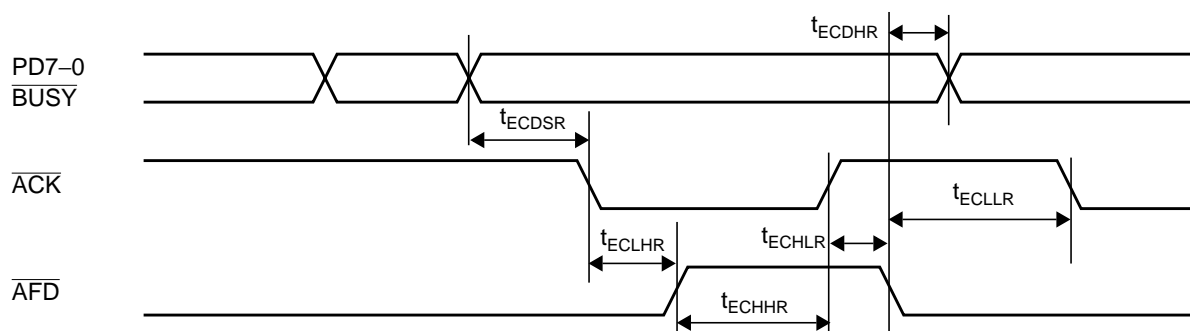
1. Not tested. Guaranteed by design.



#### Reverse Mode

Symbol	Parameter	Min	Max	Unit
$t_{ECDSR}$	Data Setup before $\overline{ACK}$ Active	0		ns
$t_{ECDHR}$	Data Hold after $\overline{AFD}$ Active	0		ns
$t_{ECLHR}$	$\overline{AFD}$ Inactive after $\overline{ACK}$ Active	75		ns
$t_{ECHHR}$	$\overline{ACK}$ Inactive after $\overline{AFD}$ Inactive <sup>1</sup>	0	35	ms
$t_{ECHLR}$	$\overline{AFD}$ Active after $\overline{ACK}$ Inactive <sup>1</sup>	0	1	s
$t_{ECLLR}$	$\overline{ACK}$ Active after $\overline{AFD}$ Active	0		ns

1. Not tested. Guaranteed by design.





## 2.0 Device Characteristics (Continued)

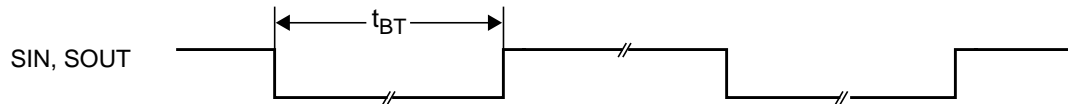
### 2.4.7 Serial Ports 1 and 2 Timing

#### Serial Port Data Timing

Symbol	Parameter	Conditions	Min	Max	Unit
$t_{BT}$	Single Bit Time in Serial Port <sup>1</sup>	Transmitter	$t_{BTN} - 25^2$	$t_{BTN} + 25^2$	ns
		Receiver	$t_{BTN} - 2\%^2$	$t_{BTN} + 2\%^2$	ns

1. Not tested. Guaranteed by design.

2.  $t_{BTN}$  is the nominal bit time in the Serial Port; it is determined by the setting of the Baud Generator Divisor registers.

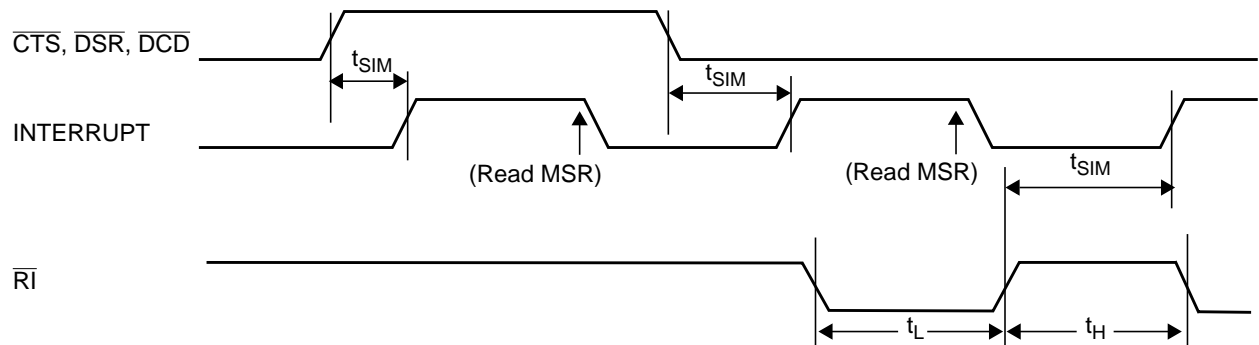


#### Modem Control Timing

Symbol	Parameter	Min	Max	Unit
$t_L$	$\overline{RI1,2}$ Low Time <sup>1,2</sup>	10		ns
$t_H$	$\overline{RI1,2}$ High Time <sup>1,2</sup>	10		ns
$t_{SIM}$	Delay to Set IRQ from Modem Input		40	ns

1. Not tested. Guaranteed by characterization.

2. The value also applies to  $\overline{RI1,2}$  wake-up detection in the SWC module



## 2.0 Device Characteristics (Continued)

### 2.4.8 Serial Port, Sharp-IR, SIR and Consumer Remote Control Timing

Symbol	Parameter	Conditions	Min <sup>1</sup>	Max <sup>1</sup>	Unit
t <sub>BT</sub>	Single Bit Time in Serial Port and Sharp-IR	Transmitter	t <sub>BTN</sub> – 25 <sup>2</sup>	t <sub>BTN</sub> + 25	ns
		Receiver	t <sub>BTN</sub> – 2%	t <sub>BTN</sub> + 2%	ns
t <sub>CMW</sub>	Modulation Signal Pulse Width in Sharp-IR and Consumer Remote Control	Transmitter	t <sub>CWN</sub> – 25 <sup>3</sup>	t <sub>CWN</sub> + 25	ns
		Receiver	500		ns
t <sub>CMP</sub>	Modulation Signal Period in Sharp-IR and Consumer Remote Control	Transmitter	t <sub>CPN</sub> – 25 <sup>4</sup>	t <sub>CPN</sub> + 25	ns
		Receiver	t <sub>MMIN</sub> <sup>5</sup>	t <sub>MMAX</sub> <sup>5</sup>	ns
t <sub>SPW</sub>	SIR Signal Pulse Width	Transmitter, Variable	( <sup>3</sup> / <sub>16</sub> ) × t <sub>BTN</sub> – 15 <sup>2</sup>	( <sup>3</sup> / <sub>16</sub> ) × t <sub>BTN</sub> + 15 <sup>2</sup>	ns
		Transmitter, Fixed	1.48	1.78	μs
		Receiver	1		μs
S <sub>DRT</sub>	SIR Data Rate Tolerance. % of Nominal Data Rate.	Transmitter		± 0.87%	
		Receiver		± 2.0%	
t <sub>SJT</sub>	SIR Leading Edge Jitter. % of Nominal Bit Duration.	Transmitter		± 2.5%	
		Receiver		± 6.5%	

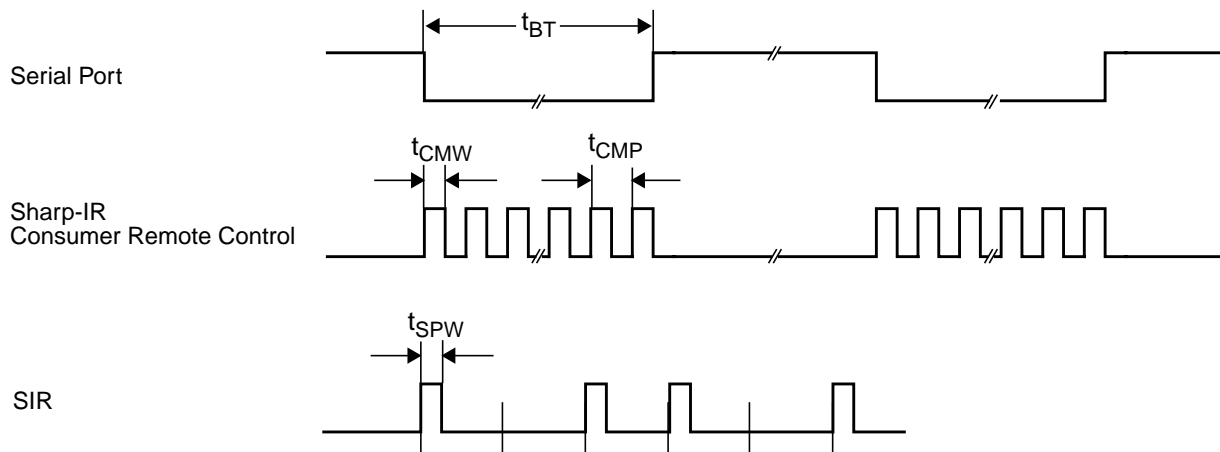
1. Not tested. Guaranteed by design.

2. t<sub>BTN</sub> is the nominal bit time in Serial Port, Sharp-IR, SIR and Consumer Remote Control modes. It is determined by the setting of the Baud Generator Divisor registers

3. t<sub>CWN</sub> is the nominal pulse width of the modulation signal for Sharp-IR and Consumer Remote Control modes. It is determined by the MCPW field (bits 7-5) of the IRTXMC register and the TXHSC bit (bit 2) of the RCCFG register

4. t<sub>CPN</sub> is the nominal period of the modulation signal for Sharp-IR and Consumer Remote Control modes. It is determined by the MCFR field (bits 4-0) of the IRTXMC register and the TXHSC bit (bit 2) of the RCCFG register.

5. t<sub>MMIN</sub> and t<sub>MMAX</sub> define the time range within which the period of the incoming subcarrier signal has to fall in order for the signal to be accepted by the receiver. These time values are determined by the contents of the IRRXDC register and the setting of the RXHSC bit (bit 5) of the RCCFG register



## 2.0 Device Characteristics (Continued)

### 2.4.9 Glue Function Timing

#### Highest Active Main and Standby Supply Reference

Symbol	Figure	Description	Reference Conditions	Min	Max
<b>Main</b>					
$t_{PD}$	11	$V_{DD3}$ to REF5V Propagation Delay <sup>1</sup>	$V_{DD5} = 0$ ; $V_{DD3}$ slew rate > 10 V/ms		1 ms
<b>Standby</b>					
$t_{PD}$	11	$V_{SB3}$ to REF5V_STBY Propagation Delay <sup>1</sup>	$V_{SB5} = 0$ ; $V_{SB3}$ slew rate > 10 V/ms		1 ms

1. Not tested. Guaranteed by design.

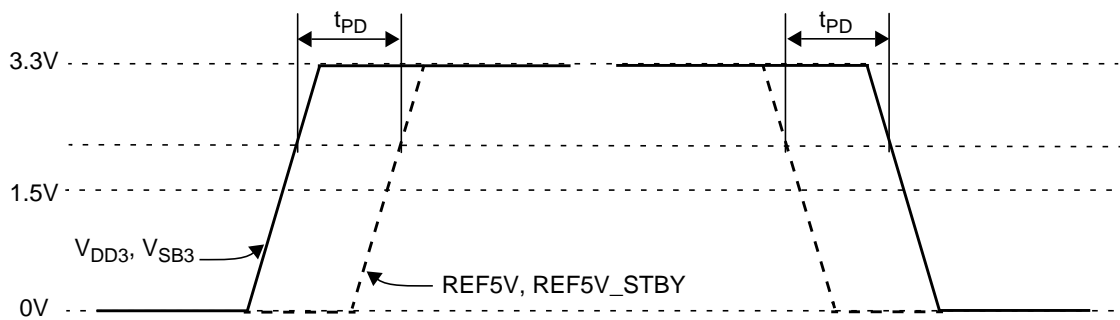


Figure 11. REF5V and REF5V\_STBY (AC Characteristics)

#### Resume Reset

Symbol	Figure	Description	Reference Conditions	Min	Max	Units
$t_{RD}$	12	Rising Supply Delay <sup>1</sup> (typ. 32 ms)	$V_{SB5} > V_{TRIP}$ and $V_{SB3} > V_{SB3ON}$	20	100	ms
$t_{FD5}$	12	Falling $V_{SB5}$ Supply Delay <sup>1</sup>	$V_{SB5} < V_{TRIP}$ and $V_{SB3} > V_{SB3ON}$		100	ns
$t_{GA}$	12	$V_{SB5}$ and $V_{SB3}$ Glitch Allowance <sup>1</sup>	$V_{SB5} < V_{TRIP}$ or $V_{SB3} < V_{SB3OFF}$		100	ns
$t_{FD3}$	12	Falling $V_{SB3}$ Supply Delay <sup>1</sup>	$V_{SB3} < V_{SB3OFF}$ and $V_{SB5} > V_{TRIP}$		100	ns
$t_R$	12	Rise Time <sup>2</sup>	$V_{SB3} > V_{SB3ON}$		100	ns
$t_F$	12	Fall Time <sup>2</sup>	$V_{SB3} > V_{SB3ON}$		100	ns

1. Not tested. Guaranteed by characterization.

2. Not tested. Guaranteed by design.

2.0 Device Characteristics (Continued)

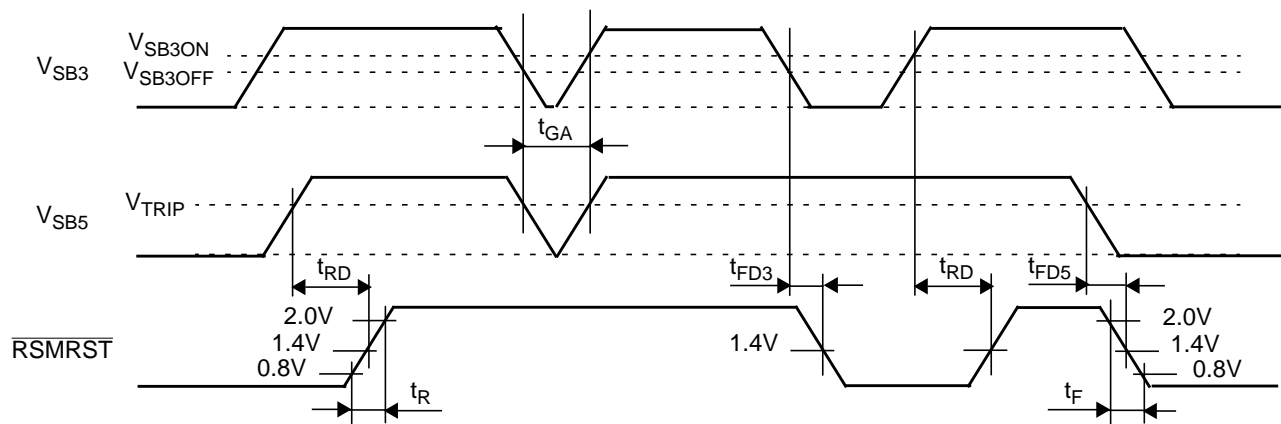


Figure 12.  $\overline{RSMRST}$  (AC Characteristics)

Main Power Good

Power Distribution Control

Symbol	Figure	Description	Reference Conditions	Min	Max	Units
$t_{PB}$	–	$\overline{BKFD\_CUT}$ Propagation Delay <sup>1</sup>	PWRGD_PS or $\overline{SLP\_S3}$ to $\overline{BKFD\_CUT}$		1	$\mu s$
$t_{TB}$	–	$\overline{BKFD\_CUT}$ Transition Time <sup>1</sup>	0.8V to 2.0V		50	ns
$t_{PL}$	13	LATCHED_BF_CUT Propagation Delay <sup>1</sup>	$\overline{BKFD\_CUT}$ or $\overline{SLP\_S5}$ to LATCHED_BF_CUT		1	$\mu s$
$t_{TL}$	13	LATCHED_BF_CUT Transition Time <sup>1</sup>	0.8V to 2.0V		50	ns

1. Not tested. Guaranteed by design.

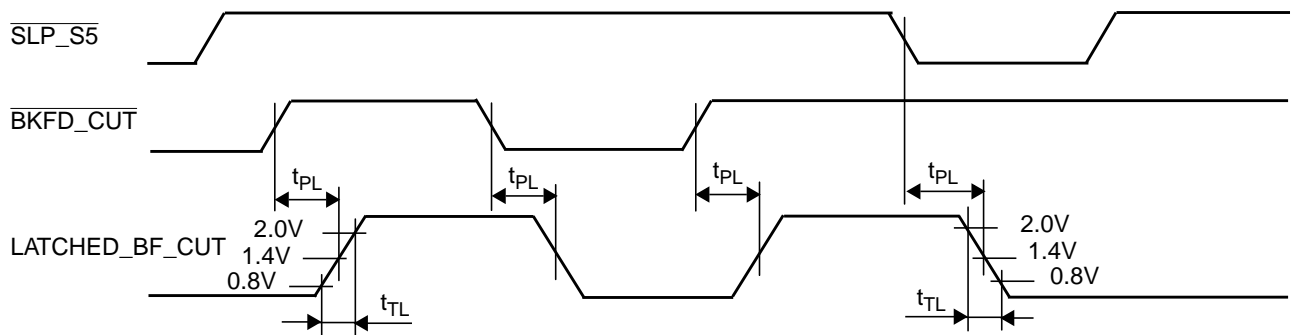


Figure 13.  $\overline{BKFD\_CUT}$  and LATCHED\_BF\_CUT (AC Characteristics)

## 2.0 Device Characteristics (Continued)

### Main Power Supply Control

Symbol	Figure	Description	Reference Conditions	Min	Max	Units
$t_{PR}$	–	Rise Propagation Delay <sup>1,2</sup>	( $\overline{\text{CPU\_PRESENT}} = 1$ ) or ( $\overline{\text{SLP\_S3}} = 0$ ) or (ETC event occurred) to RE of $\overline{\text{PS\_ON}}$		1	$\mu\text{s}$
$t_{PF}$	–	Fall Propagation Delay <sup>1</sup>	From whichever occurs last: ( $\overline{\text{CPU\_PRESENT}} = 0$ ), ( $\overline{\text{SLP\_S3}} = 1$ ), (No ETC event and RE on $\overline{\text{SLP\_S3}}$ ) to FE of $\overline{\text{PS\_ON}}$		1	$\mu\text{s}$
$t_R$	–	Rise Time <sup>1,2</sup>	0.8V to 2.0V		50	ns
$t_F$	–	Fall Time <sup>1</sup>	2.0V to 0.8V		50	ns

1. Not tested. Guaranteed by design.

2. Test conditions:  $C_L = 50 \text{ pF}$  and  $1 \text{ K}\Omega$  external resistor to  $V_{SB5}$

### SMBus Voltage Translation and Isolation Timing

Symbol	Figure	Description	Type of Requirement <sup>1</sup>	Min	Max	Unit
$t_{SMBR}$	–	Rise Time (all signals)	Input		$1000^{2,3}$	ns
$t_{SMBF}$	–	Fall Time (all signals)	Input		$250^3$	ns
			Output		$300^{2,4}$	ns
$t_{SMBD}$	–	Propagation Delay (each signal pair, in both directions)	Output		$500^{2,4}$	ns

1. An “Input” type is a value the PC8374L device expects from the system; an “Output” type is a value the PC8374L device provides to the system.

2. Test conditions:  $R_L = 1 \text{ K}\Omega$  to  $V_{DD3} = 2.25\text{V}$  or  $3.3\text{V}$ , or  $R_L = 1.5 \text{ K}\Omega$  to  $V_{DD5} = 5\text{V}$  and  $C_L = 400 \text{ pF}$  to GND.

3. Not tested. Guaranteed by design.

4. Not tested. Guaranteed by characterization.

## 2.0 Device Characteristics (Continued)

### 2.4.10 SWC Timing

#### Wake-Up Inputs at $V_{SB3}$ Power Switching

Symbol	Figure	Description	Reference Conditions	Min	Max
$t_{EWIV}$	14	External Wake-Up Inputs Valid <sup>1</sup>	At $V_{SB3}$ power on, after the 32 KHz Domain is toggling	$24576 \cdot t_{CP}^2$	$32768 \cdot t_{CP}$

1. Not tested. Guaranteed by characterization.

2.  $t_{CP}$  is the cycle time of the 32 KHz clock domain (see “Low-Frequency Clock Timing” on page 34)

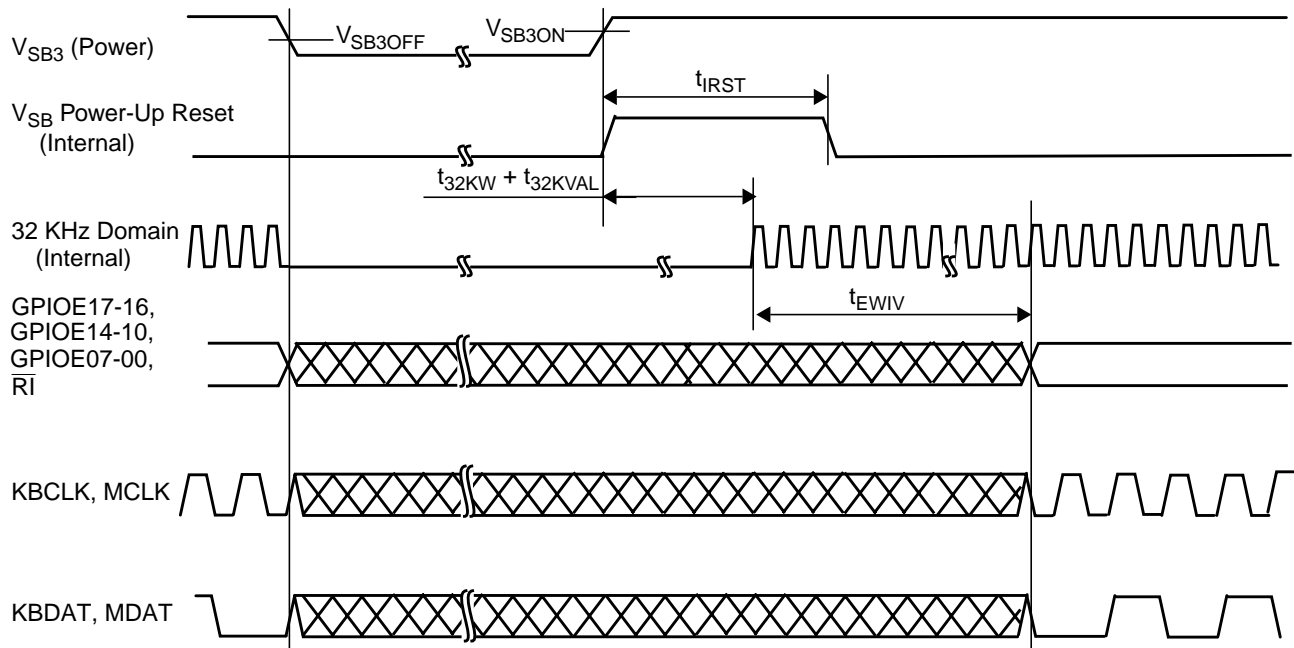


Figure 14. Inputs at  $V_{SB3}$  Power Switching

#### Wake-Up Inputs at $V_{DD3}$ Power Switching

Symbol	Figure	Description	Reference Conditions	Min	Max
$t_{EWIV}$	15	External Wake-Up Inputs Valid <sup>1</sup>	After $V_{DD3}$ power on <sup>2</sup>	$24576 \cdot t_{CP}^3$	$32768 \cdot t_{CP}$

1. Not tested. Guaranteed by characterization.

2. The 32 KHz clock domain is assumed to be toggling at  $V_{DD3}$  power stable.

3.  $t_{CP}$  is the cycle time of the 32 KHz clock domain (see “Low-Frequency Clock Timing” on page 34)

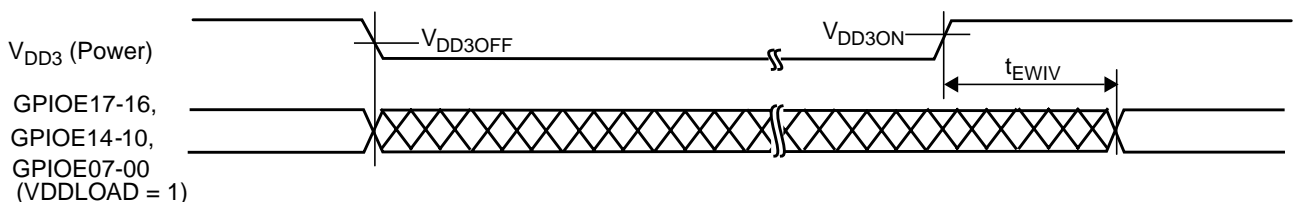


Figure 15. Wake-Up Inputs at  $V_{DD3}$  Power Switching

## 2.0 Device Characteristics (Continued)

### 2.4.11 SMBus Timing

Symbol	Figure	Description	Type of Requirement <sup>1</sup>	Min	Max	Unit
$t_{\text{SMBR}}$	16	Rise time (HMSCL and HMSDA)	Input <sup>2</sup>		1000 <sup>3</sup>	ns
$t_{\text{SMBF}}$	16	Fall time (HMSCL and HMSDA)	Input		300 <sup>3</sup>	ns
			Output <sup>2</sup>		250 <sup>4</sup>	ns
$t_{\text{SMBCKL}}$	16	Clock low period (HMSCL)	Input	4.7		$\mu\text{s}$
$t_{\text{SMBCKH}}$	16	Clock high period (HMSCL)	Input	4		$\mu\text{s}$
$t_{\text{SMBCY}}$	17	Clock cycle (HMSCL)	Input	10		$\mu\text{s}$
$t_{\text{SMBDS}}$	17	Data setup time (before clock rising edge)	Input	250		ns
			Output <sup>2</sup>	250		ns
$t_{\text{SMBDH}}$	17	Data hold time (after clock falling edge)	Input	0		ns
			Output <sup>2</sup>	300		ns
$t_{\text{SMBPS}}$	18	Stop condition setup time (clock before data)	Input	4		$\mu\text{s}$
$t_{\text{SMBSH}}$	18	Start condition hold time (clock after data)	Input	4		$\mu\text{s}$
$t_{\text{SMBBUF}}$	18	Bus free time between Stop and Start conditions (HMSDA)	Input	4.7		$\mu\text{s}$
$t_{\text{SMBRS}}$	19	Restart condition setup time (clock before data)	Input	4.7		$\mu\text{s}$
$t_{\text{SMBRH}}$	19	Restart condition hold time (clock after data)	Input	4		$\mu\text{s}$
$t_{\text{SMBLEX}}$	-	Cumulative clock low extend time from Start to Stop (HMSCL)	Output		25 <sup>3</sup>	ms
$t_{\text{SMBTO}}$	-	Clock low time-out (HMSCL)	Input	25 <sup>3,5</sup>		ms
			Output		35 <sup>3,6</sup>	ms

1. An "Input" type is a value the PC8374L expects from the system; an "Output" type is a value the PC8374L provides to the system.

2. Test conditions:  $R_L = 1 \text{ K}\Omega$  to  $V_{\text{SB}} = 3.3\text{V}$ ,  $C_L = 400 \text{ pF}$  to GND.

3. Not tested. Guaranteed by design.

4. Not tested. Guaranteed by characterization.

5. The PC8374L detects a time-out condition if HMSCL is held low for more than  $t_{\text{SMBTO}}$ .

6. Upon detection of a time-out condition, the PC8374L resets the SMBus Interface no later than  $t_{\text{SMBTO}}$ .

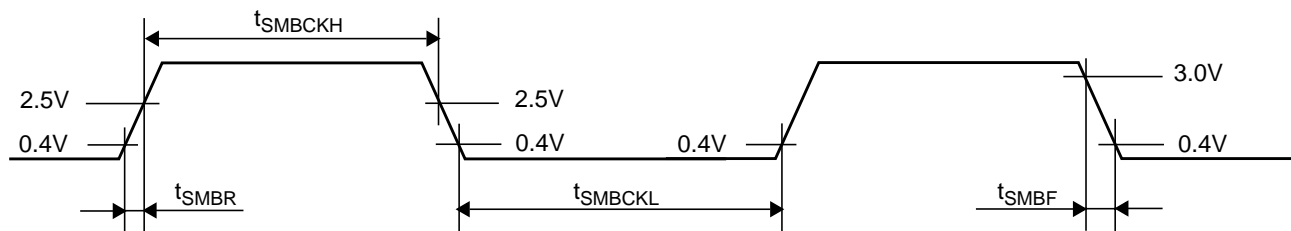


Figure 16. SMBus Signals (HMSCL and HMSDA) Rising Time and Falling Time

## 2.0 Device Characteristics (Continued)

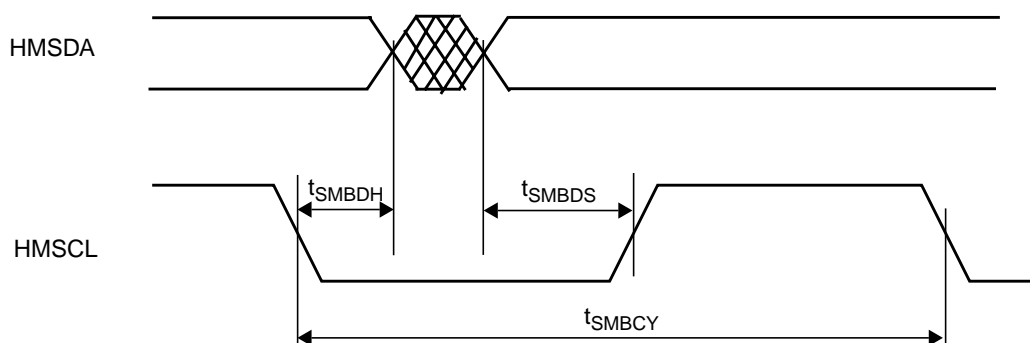


Figure 17. SMBus Data Bit Timing

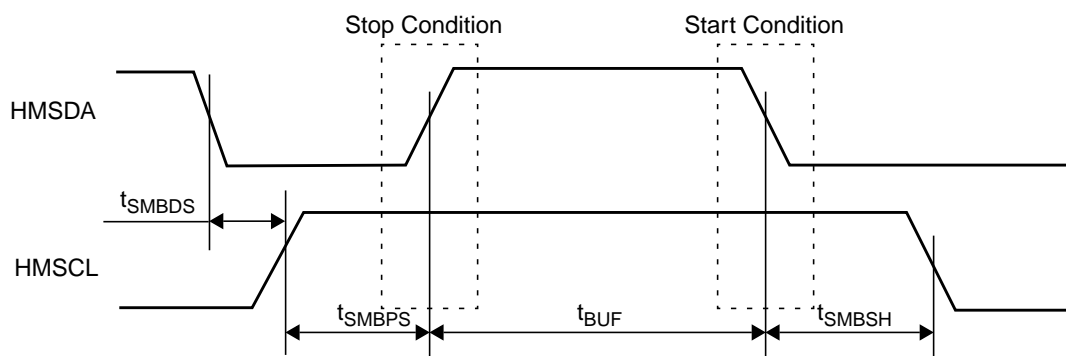


Figure 18. SMBus Start and Stop Condition Timing

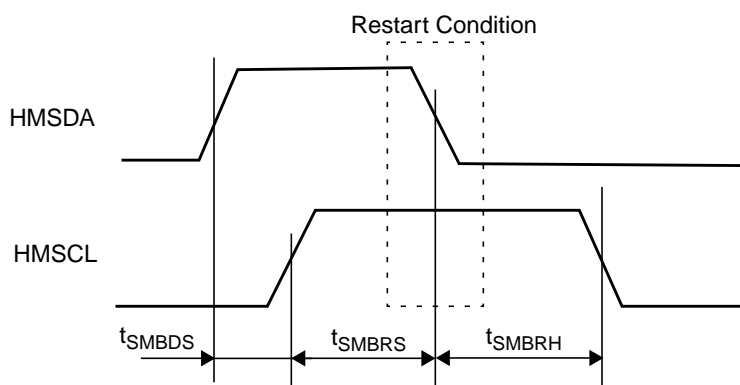
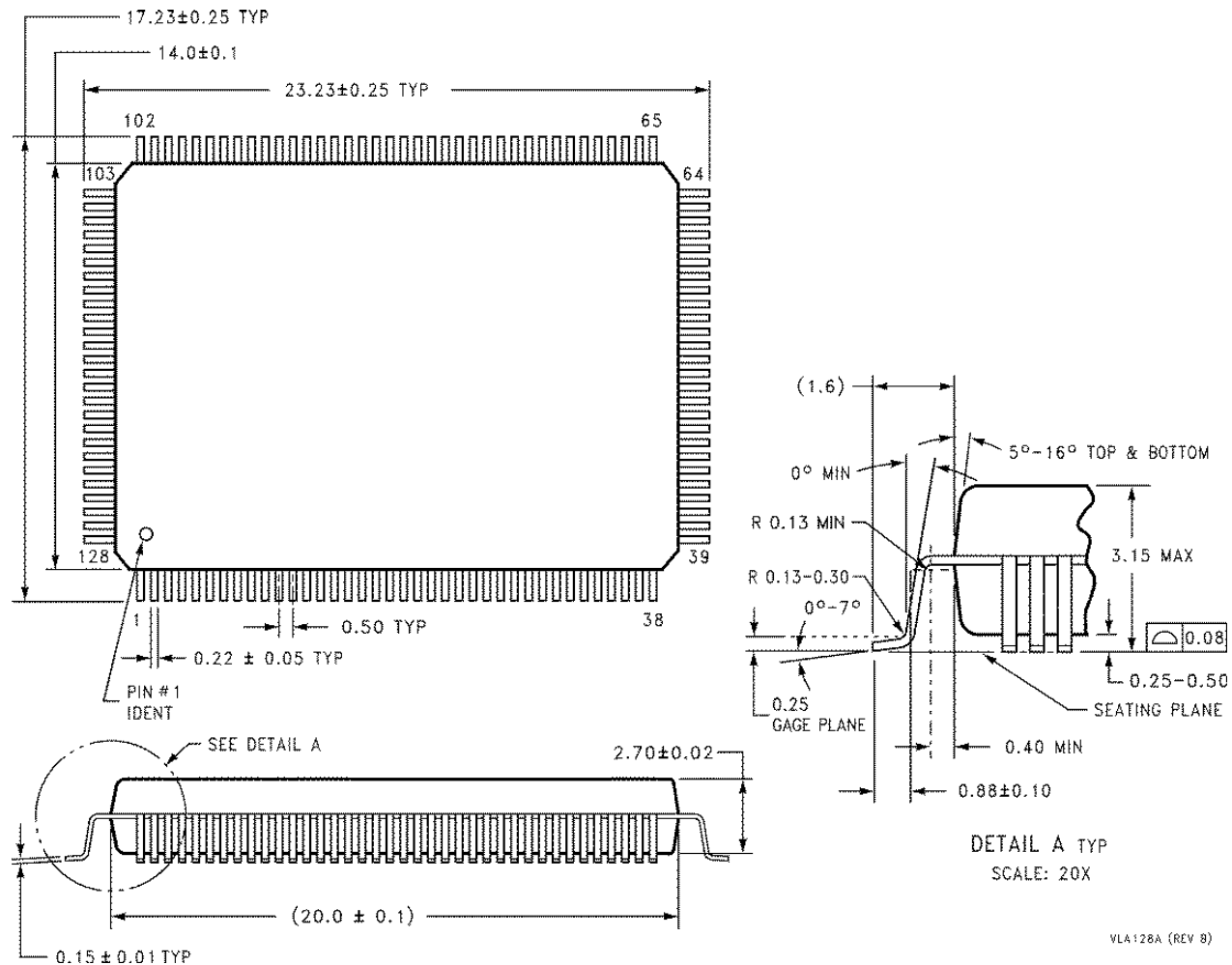


Figure 19. SMBus Restart Condition Timing



## Physical Dimensions

All dimensions are in millimeters



**Plastic Quad Flatpack (PQFP), JEDEC**  
**Order Number PC8374L-xxx/VLA**  
**NS Package Number VLA128A**

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