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## Desktop Embedded Controller with Fan Control, Hardware Monitoring and PECI

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### Highlights

- High Performance Embedded Controller (EC)
- ACPI 2.0 Compliant
- PC2001 Compliant
- LPC Interface
  - Supports LPC Bus frequencies of 19MHz to 33MHz
  - Multiplexed Command, Address and Data Bus
  - Serial IRQ Interface Compatible with Serialized IRQ Support for PCI Systems
  - PME Interface
- 3.3-Volt I/O
- 128-pin QFP RoHS Compliant Package
- System Watch Dog Timer (WDT)
- Battery Backed Resources
  - Power-Fail Status Register
  - VBat backed 64 byte memory
- Extreme Low S5
  - Enables power saving by shutting down standby voltage regulators in system S5 state
  - System wake from power button press
  - System wake from LAN
- Two EC-based SMBus 2.0 Host Controllers
  - Allows Master or Dual Slave Operation
  - Controllers are Fully Operational on Standby Power
  - DMA-driven I<sup>2</sup>C Network Layer
  - I<sup>2</sup>C Datalink Compatibility Mode
  - Multi-Master Capable
  - Supports Clock Stretching
  - Programmable Bus Speeds
  - 400 KHz Capable
  - Hardware Bus Access "Fairness" Interface
  - Detects SMBus Time-outs
  - One controller can be multiplexed onto a low voltage SMBus
- PECI Interface 2.0
  - Supports PECI REQUEST# and PECI READY signaling
  - Supports up to 2 CPUs and 4 domains
- Temperature reading from PCH over SMBus
- Temperature reading from AMD-TSI over SMBus
- Temperature Monitor
  - Monitoring up to 2 Remote Thermal Diodes plus an Anti-Parallel Remote Thermal Diode
  - Built-in ADC supports temperature readings from -63 degrees Celsius to +192 degrees Celsius
    - Supports monitoring of discrete diodes (3904 type diodes)
    - Supports monitoring substrate diodes (45nm & 65nm processor diodes)
  - Temperature resolution is 0.125 degrees Celsius
  - Internal Ambient Temperature Measurement
  - Out-of-limit Temperature Event reporting
- Bi-directional PROCHOT# Pin
  - Interrupt generation for PROCHOT Assert events
  - May be used by AMTA and PTTA features to adjust fan control limits
  - May be configured to force fans on full
  - Supports PROCHOT Assertions to external CPU
  - Supports PROCHOT Throttle Events to external CPU
  - Supports Interrupt Event to Host
- Voltage Monitor
  - Monitoring VBAT, VTR, VCC and Vtt power supplies
  - Monitoring of one external voltage
  - Limit comparison on monitored values
- PWM (Pulse width Modulation) Outputs (4)
  - Multiple Clock Rates
  - 16-bit ON and 16-bit OFF Counters
- Fan tachometer Inputs (4)
  - Programmable to monitor standard tachometer outputs or locked rotor alarm outputs
  - Generate tachometer event when speed of fan drops below programmed limit
- Internal clock sources
  - A Ring Oscillator generates 64 MHz clock
  - SIO clocks derived from a 96MHz PLL synchronized to a 14.318MHz clock input
  - Main ring generates 32kHz standby clock when external 32.768KHz clock source is off
- Low Battery Warning

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- LED Control
  - Two LEDs to indicate system state
- Programmable Wake-up Event Interface
- General Purpose Input/Output Pins (60 total)
- System Management Interrupt (SMI)
- GLUE Logic
  - 4 Buffered PCI Reset Outputs
  - Power OK Signal Generation
  - Power Sequencing
  - Power Supply Turn On Circuitry
  - Resume Reset Signal Generation
  - Speaker output
  - Intrusion Detection
- 2.88MB Super I/O Floppy Disk Controller
  - Licensed CMOS 765B Floppy Disk Controller
  - Software and Register Compatible with Microchip's Proprietary 82077AA Compatible Core
  - Configurable Open Drain/Push-Pull Output Drivers
  - Supports Vertical Recording Format
  - 16-Byte Data FIFO
  - 100% IBM® Compatibility
  - Detects All Overrun and Underrun Conditions
  - Sophisticated Power Control Circuitry (PCC) Including Multiple Powerdown Modes for Reduced Power Consumption
  - DMA Enable Logic
  - Data Rate and Drive Control Registers
  - 480 Address, Up to Eight IRQ and Four DMA Options
- Enhanced Digital Data Separator
  - 1 Mbps, 500 Kbps, 300 Kbps, 250 Kbps Data Rates
  - Programmable Precompensation Modes
- Keyboard Controller
  - 8042 Software Compatible
  - 8 Bit Microcomputer
  - 2k Bytes of Program ROM
  - 256 Bytes of Data RAM
  - Four Open Drain Outputs Dedicated for Keyboard/Mouse Interface
  - Asynchronous Access to Two Data Registers and One Status Register
  - Supports Interrupt and Polling Access
  - 8 Bit Counter Timer
  - Port 92 Support
  - Fast Gate A20 and KRESET Outputs
- Serial Ports
  - Two Full Function Serial Ports
  - High Speed NS16C550A Compatible UARTs with Send/Receive 16-Byte FIFOs
  - Programmable Baud Rate Generator
  - Modem Control Circuitry
  - Any LPC Address Configurable. 15 IRQ Options
- Multi-Mode™ Parallel Port with ChiProtect™
  - Standard Mode IBM PC/XT®, PC/AT®, and PS/2™ Compatible Bi-directional Parallel Port
  - Enhanced Parallel Port (EPP) Compatible - EPP 1.7 and EPP 1.9 (IEEE 1284 Compliant)
  - IEEE 1284 Compliant Enhanced Capabilities Port (ECP)
  - ChiProtect Circuitry for Protection
  - 960 Addresses, Up to 15 IRQ and Four DMA Options

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## 1.0 INTRODUCTION

The SCH5627P is a 3.3V PC 2001 compliant Super I/O controller with an LPC interface. All legacy drivers used for Super I/O components are supported making this interface transparent to the supporting software. The LPC bus also supports power management, such as wake-up and sleep modes.

The SCH5627P provides temperature monitoring with auto fan control. The temperature monitor is capable of monitoring up to three external diodes, one internal ambient temperature sensor or retrieving temperatures from external processors that implement the PECI Interface. This device offers programmable automatic fan control support based on one or more of these measured temperatures. There are four pulse width modulation (PWM) outputs with high frequency support as well as four fan tachometer inputs. In addition, there is support for a bi-directional PROCHOT# pin that may be used to generate an interrupt, adjust the programmed temperature limits in the auto fan control logic, or force the PWM outputs on full. The RRCC feature provides a linear relationship of temperature to fan speed.

The Glue Logic includes various power management logic; including generation of RSMRST# and Power OK signal generation. There are also two LEDs to indicate power status. The part also provides a low battery warning circuit.

The SCH5627P provides 60 General Purpose I/O control pins, which offer flexibility to the system designer.

The SCH5627P incorporates the following Super I/O components: a parallel port that is compatible with IBM PC/AT architecture, as well as the IEEE 1284 EPP and ECP; two serial ports that are 16C550A UART compatible; a keyboard/mouse controller that uses an 8042 micro controller; and a floppy disk controller.

The SCH5627P is ACPI 1.0b/2.0 compatible and supports multiple low power-down modes. It incorporates sophisticated power control circuitry (PCC), which includes keyboard and mouse wake-up events.

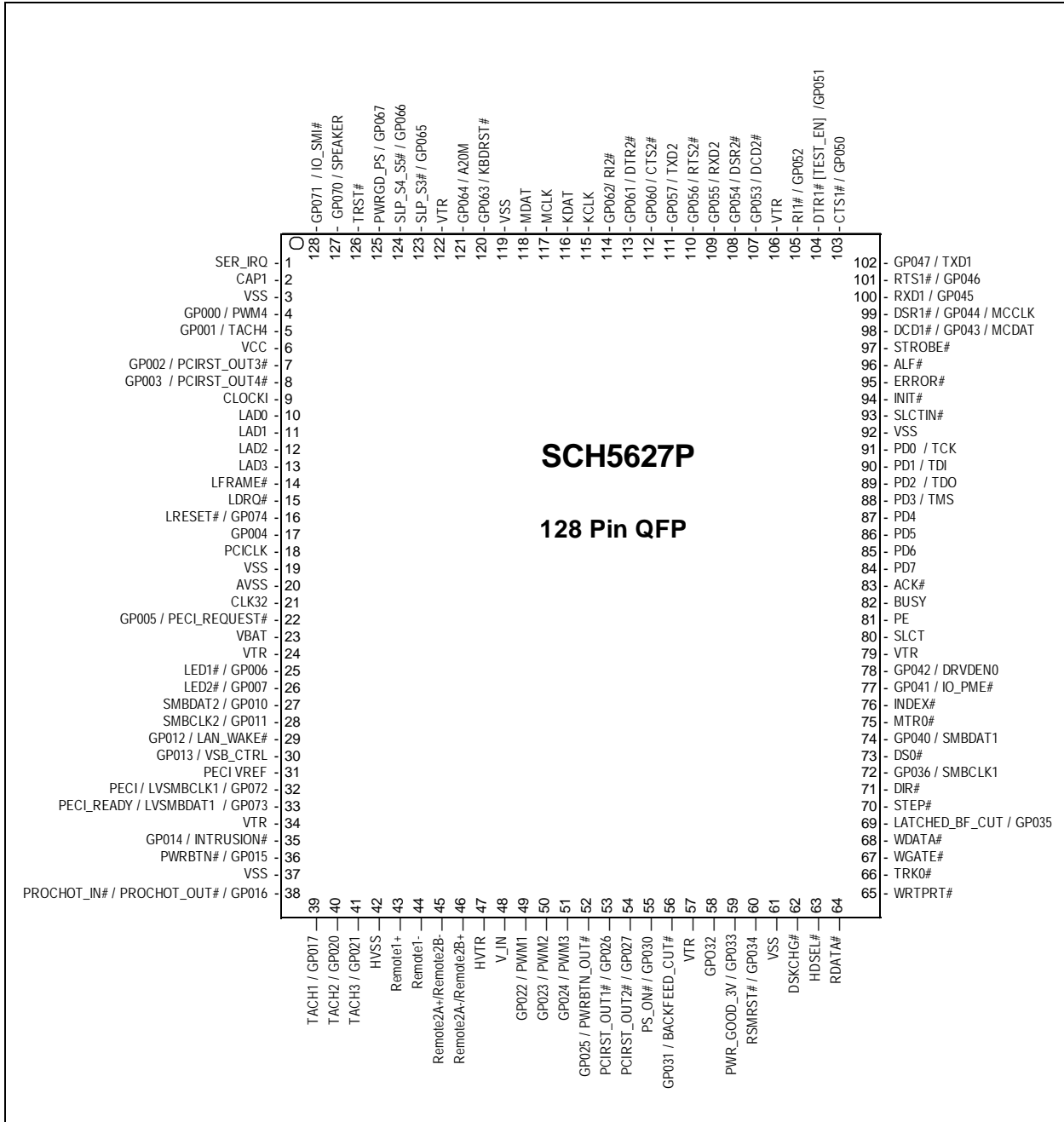
The SCH5627P incorporates a high-performance embedded microcontroller. The SCH5627P communicates with the system host using the Intel® Low Pin Count bus.

The SCH5627P is directly powered by two separate suspend supply planes (VBAT and VTR) and senses a third runtime power plane (VCC) to provide “instant on” and system power management functions. The SCH5627P also contains an integrated VTR Reset Generator and a system power management interface that supports low-power states and can drive state changes as a result of hardware wake events as defined by the SCH5627P wake interface.

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## 2.0 PIN LAYOUT

FIGURE 2-1: SCH5627P PIN DIAGRAM



## 2.1 Pin Table

Pin #	Name	Pin #	Name
1	SER_IRQ	33	PECI_READY / LVSMBDAT1 / GP073
2	CAP1	34	VTR
3	VSS	35	GP014 / INTRUSION#
4	GP000 / PWM4	36	PWRBTN# / GP015
5	GP001 / TACH4	37	VSS
6	VCC	38	PROCHOT_IN# / PROCHOT_OUT# / GP016
7	GP002 / PCIRST_OUT3#	39	TACH1 / GP017
8	GP003 / PCIRST_OUT4#	40	TACH2 / GP020
9	CLOCKI	41	TACH3 / GP021
10	LAD0	42	HVSS
11	LAD1	43	Remote1+
12	LAD2	44	Remote1-
13	LAD3	45	Remote2A+/Remote2B-
14	LFRAME#	46	Remote2A-/Remote2B+
15	LDRQ#	47	HVTR
16	LRESET# / GP074	48	V_IN
17	GP004	49	GP022 / PWM1
18	PCICLK	50	GP023 / PWM2
19	VSS	51	GP024 / PWM3
20	AVSS	52	GP025 / PWRBTN_OUT#
21	CLK32	53	PCIRST_OUT1# / GP026
22	GP005 / PECI_REQUEST#	54	PCIRST_OUT2# / GP027
23	VBAT	55	PS_ON# / GP030
24	VTR	56	GP031 / BACKFEED_CUT#
25	LED1# / GP006	57	VTR
26	LED2# / GP007	58	GPO32
27	SMBDAT2 / GP010	59	PWR_GOOD_3V / GP033
28	SMBCLK2 / GP011	60	RSMRST# / GP034
29	GP012 / LAN_WAKE#	61	VSS
30	GP013 / VSB_CTRL	62	DSKCHG#
31	PECI_VREF	63	HDSEL#
32	PECI / LVSMBCLK1 / GP072	64	RDATA#

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Pin #	Name	Pin #	Name
65	WRTPRT#	97	STROBE#
66	TRK0#	98	DCD1# / GP043 / MCDAT
67	WGATE#	99	DSR1# / GP044 / MCCLK
68	WDATA#	100	RXD1 / GP045
69	LATCHED_BF_CUT / GP035	101	RTS1# / GP046
70	STEP#	102	GP047 / TXD1
71	DIR#	103	CTS1# / GP050
72	GP036 / SMBCLK1	104	DTR1# [TEST_EN] / GP051
73	DS0#	105	RI1# / GP052
74	GP040 / SMBDAT1	106	VTR
75	MTR0#	107	GP053 / DCD2#
76	INDEX#	108	GP054 / DSR2#
77	GP041 / IO_PME#	109	GP055 / RXD2
78	GP042 / DRVDEN0	110	GP056 / RTS2#
79	VTR	111	GP057 / TXD2
80	SLCT	112	GP060 / CTS2#
81	PE	113	GP061 / DTR2#
82	BUSY	114	GP062 / RI2#
83	ACK#	115	KCLK
84	PD7	116	KDAT
85	PD6	117	MCLK
86	PD5	118	MDAT
87	PD4	119	VSS
88	PD3 / TMS	120	GP063 / KBDRST#
89	PD2 / TDO	121	GP064 / A20M
90	PD1 / TDI	122	VTR
91	PD0 / TCK	123	SLP_S3# / GP065
92	VSS	124	SLP_S4_S5# / GP066
93	SLCTIN#	125	PWRGD_PS / GP067
94	INIT#	126	TRST#
95	ERROR#	127	GP070 / SPEAKER
96	ALF#	128	GP071 / IO_SMI#

## 2.2 Changes from SCH5617

The following table lists pinout changes from the SCH5617. Because GPIO names have changed for all GPIOs, GPIO name changes have not been listed in the DIFFERENCE column. In addition, there is no distinction between Host and 8051 GPIOs; all GPIO pins can be accessed by either the EC directly or by the Host indirectly through the EMI.

**TABLE 2-1: PIN CHANGES FROM THE SCH5617**

Pin #	SCH5627P Pin Name	SCH5617 Pin Name	Difference
1	SER_IRQ	SER_IRQ	
2	CAP1	CAP1	
3	VSS	VSS	
4	GP000 / PWM4	GP8051_1 / SMB_DATA_5V	SMB_DATA_5V eliminated
5	GP001) / TACH4	GP8051_3 / SMB_DATA_2P5V	SMB_DATA_2P5V eliminated
6	VCC	VCC	



**TABLE 2-1: PIN CHANGES FROM THE SCH5617 (CONTINUED)**

Pin #	SCH5627P Pin Name	SCH5617 Pin Name	Difference
7	GP002 / PCIRST_OUT3#	GP8051_2 / SMB_CLK_5V	SMB_CLK_5V eliminated
8	GP003 / PCIRST_OUT4#	GP8051_4 / SMB_CLK_5V	SMB_CLK_2P5V eliminated
9	CLOCKI	CLOCKI	
10	LAD0	LAD0	
11	LAD1	LAD1	
12	LAD2	LAD2	
13	LAD3	LAD3	
14	LFRAME#	LFRAME#	
15	LDRQ#	LDRQ#	
16	LRESET# / GP074	LRESET#	
17	GP004	LPCPD#	LPCPD# eliminated
18	PCICLK	PCICLK	
19	VSS	VSS	
20	AVSS	AVSS	
21	CLK32	LATCHED_BF_CUT/GP23/ GP8051_18	LATCHED_BF_CUT and GPIO eliminated (LATCHED_BF_CUT moved to pin 69) 32K clock added
22	GP005 / PECI_REQUEST#	TEST	.TEST eliminated, PECI_REQUEST and GPIO added
23	VBAT	VBAT	
24	VTR	VTR	
25	LED1 / GP006	LED3 / GP60	
26	LED2 / GP007	LED2 / GP60	
27	SMBDAT2 / GP010	SDAT_1 / GP42/ IO_SMI#	SMB Isolation eliminated, IO_SMI# eliminated (moved to pin 128); SMB Dat added
28	SMBCLK2 / GP011	SDAT/ GP35 / LED1	SMB Isolation eliminated; SMB Clock added LED1 eliminated
29	GP012 / LAN_WAKE#	SCLK_1 / GP26	SMB Isolation eliminated, LAN_WAKE# added
30	GP013 / VSB_CTRL	SCLK / GP25	SMB Isolation eliminated VSB_CTRL added
31	PECI VREF	PECI VREF	
32	PECI / LVSMBCLK1 / GP072	PECI	LVSMBCLK1 added
33	PECI_READY / LVSMBDAT1 / GP073	PECI READY	LVSMBCLK1 added
34	VTR	VTR	
35	GP014 / INTRUSION	PROCHOT_OUT	PROCHOT_OUT eliminated (PROCHOT_IN#, pin 38, now bidirectional); GPIO added, INTRUSION added;
36	PWRBTN# / GP015	GP8051_47 / GP33	PWRBTN# added
37	VSS	VSS	

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**TABLE 2-1: PIN CHANGES FROM THE SCH5617 (CONTINUED)**

Pin #	SCH5627P Pin Name	SCH5617 Pin Name	Difference
38	PROCHOT_IN# / PROCHOT_OUT# / GP016	PROCHOT_I#	PROCHOT function now bidirectional
39	TACH1 / GP017	TACH1	GPIO added
40	TACH2 / GP020	TACH2	GPIO added
41	TACH3 / GP021	TACH3	GPIO added
42	HVSS	HVSS	
43	Remote1+	Remote1+	
44	Remote1-	Remote1-	
45	Remote2+	Remote2+	
46	Remote2-	Remote2-	
47	HVTR	HVTR	
48	V_IN	VIN1	
49	GP022 / PWM1	PWM1	GPIO added
50	GP023 / PWM2	PWM2	GPIO added
51	GP024 / PWM3	PWM3	GPIO added
52	GP025 / PWRBTN_OUT#	IDE_RSTDRV# / GP75	PWRBTN_OUT# added, IDE_RSTDRV# deleted
53	PCIRST_OUT1# / GP026	PCI_RST_SYS# / GP76	
54	PCIRST_OUT2# / GP027	PCI_RST_SLOTS# / GP77	
55	PS_ON# / GP030	PS_ON# / GP80	
56	GP031 / BACKFEED_CUT#	BACKFEED_CUT# / GP81	
57	VTR	VTR	
58	GPO32	GP82	
59	PWR_GOOD_3V / GP033	PWR_GOOD_3V / GP83	
60	RSMRST# / GP034	RSMRST# / GP84	
61	VSS	VSS	
62	DSKCHG#	DSKCHG#	
63	HDSEL#	HDSEL#	
64	RDATA#	RDATA#	
65	WRTPRT#	WRTPRT#	
66	TRK0#	TRK0#	
67	WGATE#	WGATE#	
68	WDATA#	WDATA#	
69	LATCHED_BF_CUT / GP035	CAP2	CAP2 eliminated
70	STEP#	STEP#	
71	DIR#	DIR#	
72	GP036 / SMBCLK1	GP22 / P12 / MRT1# / SCSI#	P12 / MTR1# / SCSI# eliminated
73	DS0#	DS0#	
74	GP040 / SMBDAT1	GP21/ P16 / DS1#	P16 / DS1# eliminated
75	MTR0#	MTR0#	
76	INDEX#	INDEX#	
77	GP041 / IO_PME#	GP41 / IO_PME#	
78	GP042 / DRVDEN0	GP40 / DRVDEN0	
79	VTR	VTR	

**TABLE 2-1: PIN CHANGES FROM THE SCH5617 (CONTINUED)**

Pin #	SCH5627P Pin Name	SCH5617 Pin Name	Difference
80	SLCT	SLCT/KDAT	KDAT eliminated
81	PE	PE/KCLK	KCLK eliminated
82	BUSY	BUSY/FALE1	Flash debug function eliminated
83	ACK#	ACK#/FALE0	Flash debug function eliminated
84	PD7	PD7/FD7_FA7	Flash debug function eliminated
85	PD6	PD6/FD6_FA6	Flash debug function eliminated
86	PD5	PD5/FD5_FA5	Flash debug function eliminated
87	PD4	PD4/FD4_FA4	Flash debug function eliminated
88	PD3 / TMS	PD3/FD3_FA3	Flash debug function eliminated; JTAG function added
89	PD2 / TDO	PD2/FD2_FA2	Flash debug function eliminated; JTAG function added
90	PD1 / TDI	PD1/FD1_FA1	Flash debug function eliminated; JTAG function added
91	PD0 / TCK	PD0/FD0_FA0	Flash debug function eliminated; JTAG function added
92	VSS	VSS	
93	SLCTIN#	SLCTIN# / FWR#	Flash debug function eliminated
94	INIT#	INIT# / FRD#	Flash debug function eliminated
95	ERROR#	ERROR#/FPGM	Flash debug function eliminated
96	ALF#	ALF#/MCLK/ FCS#	Flash debug function eliminated, MCLK eliminated
97	STROBE#	STROBE#/MDAT	MDAT eliminated
98	DCD1# / GP043 / MCDAT	DCD1#/GP8051_10	MCU Debug added
99	DSR1# / GP044 / MCCLK	DSR1#/GP8051_11	MCU Debug added
100	RXD1 / GP045	RXD1/GP8051_12	
101	RTS1# / GP046	RTS1# [SYSOPT]	
102	GP047 / TXD1	GP8051_14 / TXD1	
103	CTS1# / GP050	CTS1# / GP8051_15	
104	DTR1# [TEST_EN] / GP051	DTR1# [FLASH_EN] / GP8051_16	FLASH_EN strap eliminated, TEST_EN strap added
105	RI1# / GP052	RI1# / GP8051_17	
106	VTR	VTR	
107	GP053 / DCD2#	DCD2# / GP8051_9	
108	GP054 / DSR2#	DSR2# / GP8051_8	
109	GP055 / RXD2	GP52 / RXD2	
110	GP056 / RTS2#	GP55 / RTS2# / DDRC	DDRC removed
111	GP057 / TXD2	GP53 / TXD2	

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**TABLE 2-1: PIN CHANGES FROM THE SCH5617 (CONTINUED)**

Pin #	SCH5627P Pin Name	SCH5617 Pin Name	Difference
112	GP060 / CTS2#	CTS2# / GP8051_7	
113	GP 061 / DTR2#	GP57 / DTR2#	
114	GP062 / RI2#	RI2# / GP8051_6	
115	KCLK	KCLK	
116	KDAT	KDAT	
117	MCLK	MCLK	
118	MDAT	MDAT	
119	VSS	VSS	
120	GP063 / KBDRST#	GP36 / KBDRST#	
121	GP064 / A20M	GP37 / A20M	
122	VTR	VTR	
123	SLP_S3# / GP065	SLP_S3# / GP10	
124	SLP_S4_S5# / GP066	SLP_S4_S5# / GP11	
125	PWRGD_PS / GP067	PWRGD_PS	
126	TRST#	GP31 / SECONDARY_HD#	SECONDARY_HD# eliminated GPIO eliminated; JTAG function added
127	GP070 / SPEAKER	/ GP14 / HD_LED#	HD_LED# eliminated
128	GP071 / IO_SMI#	GP33 / PRIMARY_HD#	PRIMARY_HD# removed IO_SMI# moved to this pin

## 3.0 SIGNAL DESCRIPTIONS

### 3.1 Signal Descriptions

In the following table, each row with multiple entries represents a pin with multiple configuration options. The first entry in the row is the default configuration after VTR power on. Except as noted, pins that default to GPIOs default to inputs. All pins that default to open drain outputs are tri-stated on VTR power on.

**TABLE 3-1: SIGNAL DESCRIPTIONS**

Name <a href="#">Note 3-1</a>	Buffer Type per Function	Description	Signal Affected by VCC=0 <a href="#">Note 3-8</a>	Notes
<b>LPC INTERFACE (9)</b>				
SER_IRQ	PCI_IO	Serial IRQ pin used with the PCI_CLK pin to transfer interrupts to the host.	GATE	<a href="#">Note 3-9</a> <a href="#">Note 3-19</a>
LAD0	PCI_IO	Active high LPC signals used for multiplexed command, address and data bus.	GATE	<a href="#">Note 3-9</a>
LAD1	PCI_IO	Active high LPC signals used for multiplexed command, address and data bus.	GATE	<a href="#">Note 3-9</a>
LAD2	PCI_IO	Active high LPC signals used for multiplexed command, address and data bus.	GATE	<a href="#">Note 3-9</a>
LAD3	PCI_IO	Active high LPC signals used for multiplexed command, address and data bus.	GATE	<a href="#">Note 3-9</a>
LFRAME#	PCI_I	Active low signal indicates start of new cycle and termination of broken cycle.	GATE	<a href="#">Note 3-9</a>
LDRQ#	PCI_IO	Active low signal used for encoded DMA/Bus Master request for the LPC interface.	GATE	<a href="#">Note 3-9</a>
LRESET#	I	Active low signal used as LPC Interface Reset. PCICLK must be stable for at least 1ms before de-assertion of LRESET#	NO GATE	<a href="#">Note 3-19</a>
GP074	IO4	GPIO	NO GATE	
PCICLK	PCI_CLK	PCI clock input.	GATE	<a href="#">Note 3-9</a> <a href="#">Note 3-19</a>
<b>HARDWARE MONITOR (13)</b>				
PROCHOT_IN#	PECI_I	PROCHOT Input	GATE	<a href="#">Note 3-12</a> <a href="#">Note 3-17</a>
PROCHOT_OUT#	OD_PH	PROCHOT Output	GATE	
GP016	LVIOD24	Low voltage GPIO	NO GATE	
TACH1	I <sub>M</sub>	Input for monitoring a fan tachometer	NO GATE	<a href="#">Note 3-12</a>
GP017	IO4	GPIO	NO GATE	
TACH2	I <sub>M</sub>	Input for monitoring a fan tachometer	NO GATE	<a href="#">Note 3-12</a>
GP020	IO4	GPIO	NO GATE	
TACH3	I <sub>M</sub>	Input for monitoring a fan tachometer.	NO GATE	<a href="#">Note 3-12</a>
GP021	IO4	GPIO	NO GATE	

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**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
Remote1+	I <sub>AN</sub>	This is the positive input (current source) from the remote thermal diode. This serves as the positive input into the A/D.	NO GATE	Note 3-12
Remote1-	I <sub>AN</sub>	This is the negative Analog input (current sink) from the remote thermal diode. This serves as the negative input into the A/D.	NO GATE	Note 3-12
Remote2A+/Remote2B-	I <sub>AN</sub>	This is the positive input (current source) from the remote thermal diode. This serves as the positive input into the A/D This is also the negative input for an anti-parallel remote thermal diode.	NO GATE	Note 3-12
Remote2A-/Remote2B+	I <sub>AN</sub>	This is the negative Analog input (current sink) from the remote thermal diode. This serves as the negative input into the A/D.  This is also the positive input for an anti-parallel remote thermal diode.	NO GATE	Note 3-12
V_IN	I <sub>AN</sub>	Voltage input to A/D. Requires external resistor divider network.	NO GATE	Note 3-12
GP022 PWM1	IO4 OD4	GPIO PWM Output 1 for controlling speed of fan.	NO GATE NO GATE	Note 3-2 Note 3-12
GP023 PWM2	IO4 OD4	GPIO PWM Output 2 for controlling speed of fan.	NO GATE NO GATE	Note 3-2 Note 3-12
GP024 PWM3	IO4 OD4	GPIO PWM Output 3 for controlling speed of fan.	NO GATE NO GATE	Note 3-2 Note 3-12
GP014 / INTRUDER#	IO4	GPIO Intruder detect. Battery-backed.	NO GATE	Note 3-2 Note 3-12 Note 3-15
<b>PARALLEL PORT (17)</b>				
SLCT	I	This high active input from the printer indicates that it has power on. Bit 4 of the Printer Status Register reads the SLCT input.	GATE	Note 3-19 Note 3-7
PE	I	Another status output from the printer, a high indicating that the printer is out of paper. Bit 5 of the Printer Status Register reads the PE input	GATE	Note 3-19 Note 3-7
BUSY	I	A low active output from the printer indicating that it has received the data and is ready to accept new data. Bit 6 of the Printer Status Register reads the ACK# input.	GATE	Note 3-19 Note 3-7

**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
ACK#	I	A low active output from the printer indicating that it has received the data and is ready to accept new data. Bit 6 of the Printer Status Register reads the ACK# input.	GATE	Note 3-19 Note 3-7
PD7	IOP14	Port Data 7	GATE	Note 3-2 Note 3-3
PD6	IOP14	Port Data 6.	GATE	Note 3-2 Note 3-3
PD5	IOP14	Port Data 5	GATE	Note 3-2 Note 3-3
PD4	IOP14	Port Data 4.	GATE	Note 3-2 Note 3-3
PD3	IOP14	Port Data 3	GATE	Note 3-2 Note 3-3
TMS	I	JTAG Mode Select Input	NO GATE	Note 3-23
PD2	IOP14	Port Data 2	GATE	Note 3-2 Note 3-3
TDO	O14	JTAG Data Output	NO GATE	Note 3-23
PD1	IOP14	Port Data 1	GATE	Note 3-2 Note 3-3
TDI	I	JTAG Data Input	NO GATE	Note 3-23
PD0	IOP14	Port Data 0	GATE	Note 3-2 Note 3-3
TCK	I	JTAG Clock Input	NO GATE	Note 3-23
SLCTIN#	OD16	This active low output selects the printer. This is the complement of bit 3 of the Printer Control Register.	GATE	Note 3-2 Note 3-3 Note 3-7
INIT#	OD16	This output is bit 2 of the printer control register. This is used to initiate the printer when low.	GATE	Note 3-2 Note 3-3 Note 3-7
ERROR#	I	A low on this input from the printer indicates that there is a error condition at the printer. Bit 3 of the Printer Status register reads the ERR# input.	GATE	Note 3-19 Note 3-7
ALF#	OD8	This output goes low to cause the printer to automatically feed one line after each line is printed. The ALF# output is the complement of bit 1 of the Printer Control Register.	GATE	Note 3-2 Note 3-3 Note 3-7
STROBE#	OD8	An active low pulse on this output is used to strobe the printer data into the printer. The STROBE# output is the complement of bit 0 of the Printer Control Register.	GATE	Note 3-2 Note 3-3 Note 3-7

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**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
<b>UART 1 (8)</b>				
DCD1#	I	Active low Data Carrier Detect input for the serial port. Handshake signal which notifies the UART that carrier signal is detected by the modem. The CPU can monitor the status of DCD# signal by reading bit 7 of Modem Status Register (MSR). A DCD# signal state change from low to high after the last MSR read will set MSR bit 3 to a 1. If bit 3 of Interrupt Enable Register is set, the interrupt is generated when DCD #changes state.	GATE	Note 3-2 Note 3-4 Note 3-9
GP043	IO4	GPIO	NO GATE	
MCDAT	O4	MCU Debug data output	NO GATE	
DSR1#	I	Active low Data Set Ready input for the serial port. Handshake signal which notifies the UART that the modem is ready to establish the communication link. The CPU can monitor the status of DSR# signal by reading bit 5 of Modem Status Register (MSR). A DSR# signal state change from low to high after the last MSR read will set MSR bit 1 to a 1. If bit 3 of Interrupt Enable Register is set, the interrupt is generated when DSR# changes state.	GATE	Note 3-2 Note 3-4 Note 3-9
GP044	IO4	GPIO	NO GATE	
MCCLK	O4	MCU Debug clock output	NO GATE	
RXD1	I	Receiver serial data input for port 1	GATE	Note 3-2 Note 3-4 Note 3-9
GP045	IO4	GPIO	NO GATE	
RTS1# [SYSOPT]	O4	Active low Request to Send output for the Serial Port. Handshake output signal notifies modem that the UART is ready to transmit data. This signal can be programmed by writing to bit 1 of the Modem Control Register (MCR). The hardware reset will reset the RTS# signal to inactive mode (high). RTS# is forced inactive during loop mode operation. Defaults to tri-state on VTR power on. SYSOPT Strap. Used to determine the configuration base address. See <a href="#">Note 3-22</a> .	GATE	Note 3-2 Note 3-4 Note 3-22
GP046	IO4	GPIO	NO GATE	
GP047	IO8	GPIO	NO GATE	Note 3-2 Note 3-4 Note 3-9
TXD1	O8	Transmit serial data output for port 1.	GATE	



**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
CTS1#	I	Active low Clear to Send input for the serial port. Handshake signal which notifies the UART that the modem is ready to receive data. The CPU can monitor the status of CTS# signal by reading bit 4 of Modem Status Register (MSR). A CTS# signal state change from low to high after the last MSR read will set MSR bit 0 to a 1. If bit 3 of the Interrupt Enable Register is set, the interrupt is generated when CTS# changes state. The CTS# signal has no effect on the transmitter.	GATE	Note 3-2 Note 3-4 Note 3-9
GP050	IO4	GPIO	NO GATE	
DTR1# [Test_EN]	O4	Active low Data Terminal ready output for the Serial Port. Handshake output signal notifies modem that the UART is ready to transmit data. This signal can be programmed by writing to bit 1 of the Modem Control Register (MCR). Defaults to tri-state on VTR power on. Test Enable Strap. Used to enable test functions. Firmware samples the Test_Enable before de-asserting RSMRST# to enable the test function. Should be grounded for normal use.	GATE	Note 3-2 Note 3-4 Note 3-9, Note 3-11
GP051	IO4	GPIO	NO GATE	
RI1#	I	Active low Ring Indicator input for the serial port. Handshake signal which notifies the UART that the telephone ring signal is detected by the modem. The CPU can monitor the status of RI# signal by reading bit 6 of Modem Status Register (MSR). A RI# signal state change from low to high after the last MSR read will set MSR bit 2 to a 1. If bit 3 of Interrupt Enable Register is set, the interrupt is generated when nRI changes state.	NO GATE	Note 3-2 Note 3-4 Note 3-9
GP052	IO4	GPIO	NO GATE	
<b>UART 2 (8)</b>				
GP053	IO4	GPIO	NO GATE	Note 3-2
DCD2#	I	Data Carrier Detect 2 Input. See DCD1# pin description above.	GATE	Note 3-4 Note 3-9
GP054	IO4	GPIO	NO GATE	Note 3-2
DSR2#	I	Data Set Ready 2 Input. See DSR1# pin description above.	GATE	Note 3-4 Note 3-9
GP055	IO4	GPIO	NO GATE	Note 3-2
RXD2	I	Receive Serial Data 2 Input. See RXD1 pin description above.	GATE	Note 3-4 Note 3-9

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**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
GP056 RTS2#	IO4 O4	GPIO Request to Send 2 Output. See RTS1# pin description above.	NO GATE GATE	Note 3-2 Note 3-4
GP057 TXD2	IO8 O8	GPIO Transmit Serial Data 2 Output. See TXD1 pin description above.	NO GATE GATE	Note 3-2 Note 3-4 Note 3-9
GP060 CTS2#	IO4 I	GPIO Clear to Send 2 Input. See CTS1# pin description above.	NO GATE GATE	Note 3-2 Note 3-4 Note 3-9
GP061 DTR2#	IO4 O4	GPIO Data Terminal Ready Output. See DTR1# pin description above.	NO GATE GATE	Note 3-2 Note 3-4 Note 3-9
GP062 RI2#	IO4 I	GPIO Ring Indicator 2 Input. See RI1# pin description above.	NO GATE NO GATE	Note 3-2 Note 3-4 Note 3-9
<b>CLOCK PINS (2)</b>				
CLK32	I	32.768KHz input clock	NO GATE	
CLOCKI	I	14.318 MHz Input clock	NO GATE	
<b>FDD INTERFACE (13)</b>				
DSKCHG#	I	This input senses that the drive door is open or that the diskette has possibly been changed since the last drive selection. This input is inverted and read via bit 7 of I/O address 3F7H. The DSKCHG# bit also depends upon the state of the Force Disk Change bits in the Force Disk Change register (see Runtime Registers section).	GATE	Note 3-19
HDSEL#	OD12	Head Select Output. This high current output selects the floppy disk side for reading or writing. A logic "1" on this pin means side 0 will be accessed, while a logic "0" means side 1 will be accessed. Can be configured as an Push-Pull Output.	GATE	Note 3-2
RDATA#	I	Raw serial bit stream from the disk drive, low active. Each falling edge represents a flux transition of the encoded data.	GATE	Note 3-19
WRTPRT#	I	This active low Schmitt Trigger input senses from the disk drive that a disk is write protected. Any write command is ignored. The WRPRT# bit also depends upon the state of the Force Write Protect bit in the FDD Option register (see the Configuration Registers section).	GATE	Note 3-19
TRK0#	I	This active low Schmitt Trigger input senses from the disk drive that the head is positioned over the outermost track.	GATE	Note 3-19

**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
WGATE#	OD12	Write Gate Output. This active low high current driver allows current to flow through the write head. It becomes active just prior to writing to the diskette. Can be configured as a Push-Pull Output.	GATE	Note 3-2
WDATA#	OD12	Write Disk Data Output. This active low high current driver provides the encoded data to the disk drive. Each falling edge causes a flux transition on the media. Can be configured as a Push-Pull Output.	GATE	Note 3-2
STEP#	OD12	Step Pulse Output. This active low high current driver issues a low pulse for each track-to-track movement of the head. Can be configured as a Push-Pull Output.	GATE	Note 3-2
DIR#	OD12	Step Direction Output. This high current low active output determines the direction of the head movement. A logic "1" on this pin means outward motion, while a logic "0" means inward motion. Can be configured as a Push-Pull Output.	GATE	Note 3-2
DS0#	OD12	Drive Select 0 Output. Can be configured as a Push-Pull Output.	GATE	Note 3-19
MTR0#	OD12	Motor On 0 Output. Can be configured as a Push-Pull Output.	GATE	Note 3-19
INDEX#	I	This active low Schmitt Trigger input senses from the disk drive that the head is positioned over the beginning of a track, as marked by an index hole.	GATE	Note 3-19
GP042 DRVDEN0	IO12 O12	GPIO Drive Density Select 0 Output.	NO GATE GATE	Note 3-2 Note 3-4
<b>MISCELLANEOUS (28)</b>				
GP003 PCIRST_OUT4	IO8 O8	GPIO Buffered PCI RESET#	NO GATE NO GATE	Note 3-2 Note 3-4
GP000 PWM6	IO8 O8	GPIO PWM Output 6 for controlling speed of fan	NO GATE NO GATE	Note 3-2 Note 3-4
GP002 PCIRST_OUT3#	IO8 O8	GPIO Buffered PCI RESET#	NO GATE NO GATE	Note 3-2 Note 3-4
GP001 TACH4	IO8 I	GPIO Input for monitoring a fan tachometer	NO GATE NO GATE	Note 3-2 Note 3-4
PWRBTN# GP015	 IO4	Power Button input GPIO	NO GATE NO GATE	Note 3-2 Note 3-4

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**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
GP041 IO_PME#	IO4 OD4	GPIO Power Management Event output. This active low Power Management Event signal allows this device to request wakeup.	NO GATE NO GATE	Note 3-2 Note 3-4
SMBDAT2 GP010	IOD4 IO4	SMBus Data GPIO	NO GATE NO GATE	Note 3-2 Note 3-4
SMBCLK2 GP011	IOD4 IO4	SMBus Clock GPIO	NO GATE NO GATE	Note 3-2 Note 3-4
GP040 SMBDAT1	IO4 IOD4	GPIO SMBus Data	NO GATE NO GATE	Note 3-2 Note 3-4
GP036 SMBCLK1	IO4 IOD4	GPIO SMBus Clock	NO GATE NO GATE	Note 3-2 Note 3-4
LED1  GP006	O8  IO8	Active Low LED Output – ON, OFF, Blink. Blinks at 1Hz rate with a 50% duty cycle. When RSMRST# is asserted the blink rate can range from 0.33Hz to 1.0Hz due to Ring Oscillator variations GPIO	NO GATE  NO GATE	Note 3-2 Note 3-4
LED2  GP007	O8  IO8	Active Low LED Output – ON, OFF, Blink. Blinks at 1Hz rate with a 50% duty cycle. When RSMRST# is asserted the blink rate can range from 0.33Hz to 1.0Hz due to Ring Oscillator variations. GPIO	NO GATE  NO GATE	Note 3-2 Note 3-4
GP025 PWRBTN_OUT#	IO8 OD8	GPIO Power button out, used to wake core logic from Extreme Low S5	NO GATE NO GATE	Note 3-2 Note 3-4 Note 3-24
LATCHED_BF_CUT GP035	O8 IO8	Latched Backfeed Cut GPIO	NO GATE NO GATE	Note 3-2 Note 3-4 Note 3-20
GP031 BACKFEED_CUT#	IO8 OD8	GPIO Backfeed Cut	NO GATE NO GATE	Note 3-2 Note 3-4
PCIRST_OUT1# GP026	O4 IO4	Buffered PCI RESET# GPIO	NO GATE NO GATE	Note 3-2 Note 3-4
PCIRST_OUT2# GP027	O4 IO4	Buffered PCI RESET#. GPIO	NO GATE NO GATE	Note 3-2 Note 3-4
PS_ON#/ GP030	OD4 IO4	Power Supply Turn-On (Open Drain Output) GPIO	NO GATE NO GATE	Note 3-2 Note 3-4 Note 3-21
PWR_GOOD_3V GP033	O4 IO4	Power Good Output GPIO	NO GATE NO GATE	Note 3-2 Note 3-4 Note 3-20
RSMRST# GP034	O4 IO4	Resume Reset Output GPIO	NO GATE NO GATE	Note 3-2 Note 3-4 Note 3-20

**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
SLP_S3#	I	Sleep S3 power plane control Input. An active low indicates that the system is in the Suspend to RAM state.	NO GATE	Note 3-2 Note 3-4 Note 3-13
GP065	IO4	GPIO	NO GATE	
SLP_S4_S5#	I	Sleep S5 power plane control Input. An active low indicates that the system is in the Soft Off state. General Purpose I/O	NO GATE	Note 3-2 Note 3-4 Note 3-13
GP066	IO4	GPIO	NO GATE	
PWRGD_PS	I	Active high Power Good Input to indicate that VCC. (Input to VTR powered logic)	NO GATE	Note 3-2 Note 3-4 Note 3-13
GP067	IO4	GPIO	NO GATE	
GP070	IO4	GPIO	NO GATE	Note 3-2 Note 3-4
SPEAKER	O4	SPEAKER Output	NO GATE	
GP071	IO4	GPIO	NO GATE	Note 3-2 Note 3-4
IO_SMI#	OD4	System Management Interrupt	NO GATE	
TRST#	I	JTAG Reset input Must be tied to ground during normal use.	NO GATE	
LAN_WAKE#	I	Wake from Extreme Low S5 from LANactivity	LAN_WAKE#	
GP012	IO4	GPIO	NO GATE	
GP004	IO16	GPIO Forced low on VTR power on or after a Watchdog Timer event	NO GATE	
VSB_CTRL	O16	Extreme Low S5control for external power regulator	NO GATE	Note 3-25
GP013	IO16	GPIO Forced low on VTR power on	NO GATE	
GP032	IO8	GPIO Forced high on VTR power on or after a Watchdog Timer event	NO GATE	
<b>KEYBOARD AND MOUSE(6)</b>				
KCLK	IOD12	Keyboard Clock I/O	NO GATE	Note 3-19
KDAT	IOD12	Keyboard Data I/O	NO GATE	Note 3-19
MCLK	IOD12	Mouse Clock I/O	NO GATE	Note 3-19
MDAT	IOD12	Mouse Data I/O	NO GATE	Note 3-19
GP063	IO4	GPIO	NO GATE	Note 3-2 Note 3-4 Note 3-5
KBDRST#	OD4	Keyboard Reset Open-Drain Output.	GATE	
GP064	IO4	GPIO	NO GATE	Note 3-2 Note 3-4 Note 3-5
A20M	OD4	Gate A20 Open-Drain Output.	GATE	
<b>PECI INTERFACE (4)</b>				
PECI V <sub>REF</sub>	PECI_VREF	PECI IO Voltage Source. 0.95V to 1.26V		

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**TABLE 3-1: SIGNAL DESCRIPTIONS (CONTINUED)**

Name Note 3-1	Buffer Type per Function	Description	Signal Affected by VCC=0 Note 3-8	Notes
PECI LVSMBCLK1 GP072	PECI_IO LVIOD4 LVIOD4	PECI Data IO Low voltage SMBus clock. GPIO  All functions on this pin are at the PEGI voltage.	GATE NO GATE NO GATE	Note 3-18
PECI_READY LVSMBDAT1 GP073	PECI_I LVIOD4 LVIO4	PECI Ready to read Low voltage SMBus data. GPIO  All functions on this pin are at the PEGI voltage.	GATE NO GATE NO GATE	Note 3-16 Note 3-18
GP005 PECI_REQUEST#	IO4 OD4	GPIO PECI Request. This pin is open-drain and should be pulled up to VCC.	NO GATE GATE	Note 3-2 Note 3-4
<b>POWER AND GROUND (18)</b>				
VCC	pwr	VCC power indication	-	-
VTR	pwr	3.3V Supply Voltage	-	-
VTR	pwr	3.3V Supply Voltage	-	-
VTR	pwr	3.3V Supply Voltage	-	-
VTR	pwr	3.3V Supply Voltage	-	-
VTR	pwr	3.3V Supply Voltage	-	-
VTR	pwr	3.3V Supply Voltage	-	-
VBAT	pwr	Battery Input Voltage	-	-
HVTR	pwr	Hardware Monitor 3.3V Supply Voltage	-	Note 3-6
VSS	gnd	Digital Ground	-	-
VSS	gnd	Digital Ground	-	-
VSS	gnd	Digital Ground	-	-
VSS	gnd	Digital Ground	-	-
VSS	gnd	Digital Ground	-	-
VSS	gnd	Digital Ground	-	-
AVSS	agnd	Analog Ground	-	-
HVSS	gnd	Hardware Monitor Ground	-	-
CAP1	regulator	Regulator filter 4.7 $\mu$ F $\pm$ 20% Capacitor to ground (ESR $\leq$ 2 ohms)	-	-

**Note 3-1** Names in parentheses are software functions.

**Note 3-2** Output Buffers are 5V tolerant in open drain mode only.

**Note 3-3** When PWRGD\_PS is 0 the buffers are tri-stated.

**Note 3-4** If a pin is used as a push pull output, it is not 5V tolerant and should not be pulled up to 5V.

**Note 3-5** External pullups must be placed on the KBDRST# and A20M pins. These pins are GPIOs that are inputs after an initial power-up (VTR POR). If the KBDRST# and A20M functions are to be used, the system must ensure that these pins are high.

**Note 3-6** HVTR must be connected to the suspend power well (VTR).

**Note 3-7** Refer to Parallel Port description for use of this pin in ECP and EPP mode.

- Note 3-8** **NO GATE** indicates that the pin is not protected, or affected by  $V_{CC} = 0$  operation. **GATE** indicates that the pin is protected as an input, or set to a **HI-Z** state as an output. The **GATE** function applies when  $V_{CC}$  is below the trip point in the reset generator, when the pin PWRGD\_PS is low (de-asserted) or when the pin SLP\_S3# is low (asserted).
- Note 3-9** The **GATE** function also applies to this pin when pin LRESET# is low (asserted).
- Note 3-10** Buffer is active when GPIO selected.
- Note 3-11** Footprints for a Pull-Up and a Pull-Down resistor should be placed near pin 104 to strap the Test\_EN function. A pull-up to VTR will enable the test interface on VTR POR; a 0 will disable the interface.
- Note 3-12** These function are on HVTR power supply.
- Note 3-13** When this pin is configured as a GPIO, the alternate function input is forced high.
- Note 3-14** The PWRBTN# function is always enabled, even when the pin is configured as a GPIO output. It is not affected by the GPIO configuration parameters, including polarity.
- Note 3-15** The INTRUDER# function is always enabled, even when the pin is configured as a GPIO output. It is not affected by the GPIO configuration parameters, including polarity.
- Note 3-16** The PECL\_Ready Signal should ONLY be connected to signals that are on the VTT rail. Connect to VTT, PCI Reset or PCI Clockrun.
- Note 3-17** When this pin is configured for PROCHOT\_OUT# or GPIO, the pad type must be set to Open Drain.
- Note 3-18** Both the pin mux control and the pad type control (Push-Pull for PECL and Open Drain for LVSMB) must be configured to switch this pin between PECL and LVSMBUS. When this pin is configured for PECL and push-pull, the pad drive strength is weak, as defined for PECL; when this pin is configured for Low Voltage SMBus and open-drain, the drive strength is as defined by the buffer type.
- Note 3-19** This Pin is 5V tolerant.
- Note 3-20** This Pin is forced low and glitch-protected until VTR is stable and internal power supplies have stabilized.
- Note 3-21** This Pin is held in tri-state and glitch-protected until VTR is stable and internal power supplies have stabilized.
- Note 3-22** Footprints for a Pull-Up and a Pull-Down resistor should be placed near pin 101 to strap the SYSOPT function. A 0 will set the configuration base address to 002Eh; a pull-up to VCC will set the configuration base address to 004Eh.
- Note 3-23** The JTAG signal becomes active when the TRST# pin is high.
- Note 3-24** When used as PWRBTN\_OUT#, this pin requires an external pull-up to the power supply on the board.
- Note 3-25** The board must have the proper pull-up on the VSB\_CTL pin to allow VSB power to turn on. In this case, when going into XLS5 the device will be sinking current through the resistor, so there will be a DC current through the resistor in XLS5.

## 3.2 Buffer Type Description

**Note:** The buffer type values are specified at  $V_{CC}=3.3V$ .

**TABLE 3-2: BUFFER TYPES**

Buffer Type	Description
I	Input with Schmitt Trigger with 400mV hysteresis, TTL Compatible.
I <sub>M</sub>	Input - Hardware Monitoring Block.
I <sub>AN</sub>	Analog Input, Hardware Monitoring Block.
IO4	Input/Output, 4mA sink, 4mA source.
O4	Output, 4mA sink, 4A source.
OD4	Output (Open Drain), 4mA sink
IO8	Input/Output, 8mA sink, 8mA source.

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**TABLE 3-2: BUFFER TYPES (CONTINUED)**

Buffer Type	Description
O8	Output, 8mA sink, 8mA source.
OD8	Output (Open Drain), 8mA sink
IO12	Input/Output, 12mA sink, 12mA source.
O12	Output, 12mA sink, 12mA source.
OD12	Output (Open Drain), 12mA sink.
IOD12	Input/Output (Open Drain), 12mA sink.
IOP14	Input/Output, 14mA sink, 14mA source. Backdrive protected.
IO16	Input/Output, 16mA sink, 16mA source
O16	Output, 16mA sink, 16mA source
OD16	Output (Open Drain), 16mA sink.
IO24	Input/Output, 24mA sink, 24mA source.
LVIOD4	Input/Output (Open Drain), $V_{REF} = 1.2V$ , $I_{OL} = 4ma$ . See DC Electrical Characteristics section.
LVIO4	Input/Output, $V_{REF} = 1.2V$ , $I_{OL} = 4ma$ . See DC Electrical Characteristics section.
LVIOD24	Input/Output (Open Drain), $V_{REF} = 1.2V$ , $I_{OL} = 24ma$ . See DC Electrical Characteristics section.
IOD_PH	Input/Output (Open Drain), $V_{REF} = 1.2V$ , $I_{OL} = 24ma$ . See DC Electrical Characteristics section.
OD_PH	Output (Open Drain), $V_{REF} = 1.2V$ , $I_{OL} = 24ma$ . See DC Electrical Characteristics section.
PCI_I	Input. These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 3-26</a> )
PCI_O	Output. These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 3-26</a> )
PCI_IO	Input/Output These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 3-26</a> )
PCI_CLK	Clock Input. These pins meet the PCI 3.3V AC and DC Characteristics and timing. ( <a href="#">Note 3-27</a> )
PECI_I	Input. These pins are at the Peci $V_{REF}$ level
PECI_IO	Input/Output These pins are at the Peci $V_{REF}$ level

**Note 3-26** See the "PCI Local Bus Specification," Revision 2.1, Section 4.2.2.

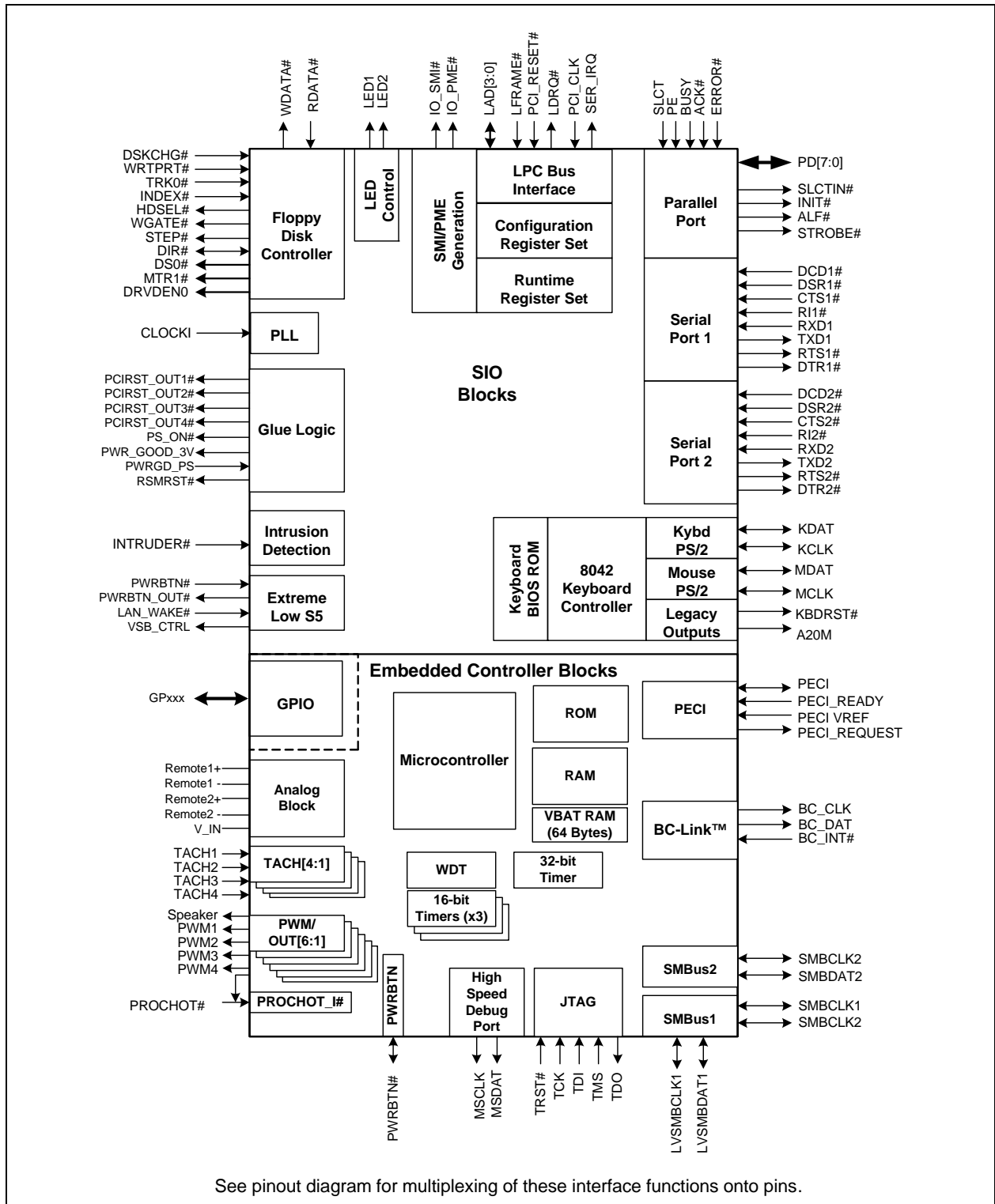
**Note 3-27** See the "PCI Local Bus Specification," Revision 2.1, Section 4.2.2 and 4.2.3.



## 4.0 BLOCK DIAGRAM

Figure 4-1 shows, in graphic form, the inter-connectivity of devices on the SCH5627P, including the EC, the principal lower buses and most of the peripherals.

FIGURE 4-1: SCH5627P BLOCK DIAGRAM



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## 4.1 Host Logical Devices

Table 4-1 shows the set of Logical Devices that are Host-accessible on the SCH5627P.

TABLE 4-1: HOST LOGICAL DEVICES ON SCH5627P

Logical Device Number	Logical Devices	Runtime Registers	Configuration Registers	EC-only Registers
0h	EM Interface	yes	no	yes
1h	Keyboard Controller (8042)	yes	yes	no
7h	UART1	yes	yes	no
8h	UART2	yes	yes	no
Ah	Runtime Registers	yes	yes	yes
Bh	Floppy Disk Controller	yes	yes	no
Ch	LPC Interface	no	yes	yes
11h	Parallel Port	yes	yes	no
3Fh	Global Configuration	no	no	yes

## 4.2 Register Table Conventions

### 4.2.1 REGISTER TYPE

A register type of “R” means that all bits within the register are read-only. All stores to these registers are ignored.

A register type of “W” means that all bits within the register are write-only. Any read from one of these registers returns 0.

A register type of “R/W” means that at least one bit in the register is read/write.

A register type of “R/WC” means that all bits in the register are either read-only or read/write-clear. A read/write-clear bit is cleared to 0 when written with a ‘1b’. A write of a ‘0b’ to the bit has no effect. Unless otherwise noted, the bit is not cleared on a write of ‘1b’ if hardware is simultaneously setting the bit to ‘1b’.

A register type of “R/WS” means that all bits in the register are either read-only or read/write-set. A read/write-clear bit is set to 1 when written with a ‘1b’. A write of a ‘0b’ to the bit has no effect.

### 4.2.2 REGISTER FIELDS

A field labeled “Reserved” always returns 0. Writes to a reserved field are ignored.

A field labeled “MCHP Reserved” is reserved for Microchip use. Reads should be ignored and any write should be 0. Writes of a ‘1b’ to a field labeled “MCHP Reserved” may have unpredictable results.

## 5.0 POWER, CLOCKS AND RESET

### 5.1 Power

The SCH5627P is a 3.3V IO part. The expected external supply voltage is 3.3 Volts (nominal).

Exceptions to the 3.3V IOs are PROCHOT# pin, the two Low Voltage SMBus pins (LVSMBCLK1/LVSMBDAT1), and the PECL pins (PECL and PECL\_Ready). See [Section 3.0, "Signal Descriptions"](#).

#### 5.1.1 EXTERNAL SUPPLY VOLTAGES

The SCH5627P is connected to three external voltage supplies: trickle supply VTR (3.3V nominal), battery supply VBAT (3V nominal), and main supply VCC (3.3V nominal). See [Section 21.0, "Electrical Specifications," on page 202](#) for detailed requirements on these supply voltages.

VTR is the primary power source. It powers most of the SCH5627P's circuitry when on. When VTR is off, the SCH5627P switches (internally) to the secondary supply VBAT (3V nominal) to power certain logic and registers, including VBAT RAM; the rest is powered down along with VTR. VCC is used only to sense when the system's main power is on. Certain legacy modules and pins are activated only when VCC is on. They are inactive otherwise.

The switch from VTR to VBAT takes place as follows:

- On rising VTR, switch from VBAT to VTR when  $VTR > 2.5V$  (nominal) or  $VTR > VBAT$ .
- On falling VTR, switch from VTR to VBAT when  $VTR < 2.45V$  (nominal) and  $VTR < VBAT$ .

Backdrive protection prevents VBAT from driving the VCC or VTR rails.

When VTR and VCC are fully powered, the potential difference between the two supplies must not exceed 500mV.

The analog circuitry used in the Hardware Monitor in the SCH5627P requires its own copy of the VTR voltage. This supply is connected to the HVTR pin.

In addition to the three voltage supplies, the SCH5627P can also be connected to the CPU voltage, through the PECL\_VREF pin. This voltage is used to provide a reference for the PECL circuitry as well as the Low Voltage SMBus.

All four of these voltages, as well as an additional external voltage connected to the V\_IN pin, can be monitored by the Hardware Monitor.

#### 5.1.2 INTERNAL SUPPLY VOLTAGES.

A 1.2V regulator generates the SCH5627P core power well. The input to the 1.2V Regulator is VTR. The 1.2V Regulator is not used when VTR is inactive.

The stability of the 1.2V Regulator amplifier depends on an external capacitor, VR\_CAP. The capacitor requirement is defined in [Table 3-1, "Signal Descriptions," on page 11](#). The choice of capacitor can be either ceramic or low ESR tantalum. Ceramics are the recommended choice due to their superior AC performance (below 100mΩ ESR), but X5R dielectrics should be used to prevent greater than 20% capacitance variation over temperature and voltage. Low ESR tantalum capacitors will work but care should be taken because the ESR can vary 2x at low temperatures.

#### 5.1.3 VTR

All EC logic, including the 64.52MHz ring oscillator, is powered by VTR and not affected by the presence or absence of VCC. Super I/O devices are de-activated when VCC is off. The following Host-side devices remain activated and operating on VTR even when VCC is off:

- Runtime register block (includes all PME, SMI, GPIO, and other miscellaneous registers)
- PME interface block
- "Wake on Specific Key" logic
- LED control logic
- Low battery detection logic
- Glue Logic
- GPIO Pins

#### 5.1.4 VBAT

There are two acceptable types of SCH5627P power supply configuration that fundamentally differ based on the need for a backup battery connection to VBAT.

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## 5.1.4.1 TYPE 1

Type 1 configurations do not use a VBAT backup battery connection. Power supply requirements for Type 1 configurations are as follows: VBAT is tied to VTR and VTR is connected to the suspend supply.

In this configuration internal components that utilize the VBAT power plane are switched internally to VTR using a Power Multiplexer when VTR power is applied.

In this configuration, the state of VBAT-backed resources like the VBAT Powered RAM and the VBAT-backed status bits are not preserved when VTR power is removed.

## 5.1.4.2 TYPE 2

Type 2 configurations use an un-switched VBAT backup battery connection. Power supply requirements for Type 2 configurations are as follows: VBAT is connected to an un-switched backup battery and VTR is connected to the suspend supply.

In this configuration internal components that utilize the VBAT power plane are switched internally to VTR using a Power Multiplexer when VTR power is applied.

**APPLICATION NOTE:** Microchip recommends removing all power to the device (VCC and VTR) before removing and replacing the battery. In addition, upon removing the battery, ground the battery pin through a resistor before replacing the battery.

## 5.2 Clocks

### 5.2.1 32.768KHZ CLOCK INPUT

The 32.768KHz CLK32 clock is a single-ended input. The system core logic will typically provide an accurate 32.768KHz clock whenever RSMRST# is de-asserted. When the 32KHz clock input is not available, the internal 32KHz clock is derived from an internal ring oscillator.

The CLK32 input is ensured glitch-free on VTR rise.

The 32K Clock domain is used for the EC Watchdog Timer and it provides a time base for blinking for the LED logic described in [Section 18.8, "LED Pins," on page 178](#).

### 5.2.2 14.318MHZ CLOCK INPUT

A PLL generates 96MHz clock from the 14.318 MHz input clock. This clock and its scaled-down versions are used in the UART, parallel port, floppy disk controller and keyboard interface modules.

### 5.2.3 PCI CLOCK

The 33MHz clock is used in the LPC interface. The presence or absence of the PCI Clock can be monitored. The status is readable by the EC in an internal status bit.

## 5.3 Reset

### 5.3.1 VBAT\_POR

VBAT\_POR is a pulse that is asserted at the rising edge of VTR if the coin cell is replaced while VTR is off, or if the VBAT voltage falls below 1.25 V nominal while VTR rises above its operational threshold. No action is taken if the coin cell is replaced, or the VBAT voltage falls below 1.25 V nominal while VTR is present.

VBAT\_POR is used to reset internal battery-powered registers. A Low\_Bat status bit is also available for both PME and SMI event generation.

### 5.3.2 NSYS\_RST

nSYS\_RST is the main system reset. It is asserted as soon as VTR power is applied.

[nSYS\\_RST](#) is also asserted as soon as the VTR power supply drops below its preset threshold.

### 5.3.3 VCC RESET

The VCC RESET signal is generated when the VCC voltage is below a threshold. VCC Reset is part of [nSIO\\_RESET](#) and is also used in reset some individual registers as noted.

There are two indications of the state of the main power supply: the PWRGD\_PS input pin and the internal VCC reset generator, which monitors the voltage level of VCC. PWRGD\_PS is not used as part of VCC RESET or nSIO\_RESET, but is used to gate SIO logical devices that are powered by an emulated VCC power supply. See [Table 3-1, "Signal Descriptions," on page 11](#), for a list of all pins whose activity is gated by VCC RESET or PWRGD\_PS.

#### 5.3.4 PCI RESET#

The PCI RESET signal is generated whenever the LRESET# pin is low: PCI RESET# is part of nSIO\_RESET.

#### 5.3.5 NSIO\_RESET

nSIO\_RESET is a signal that is asserted when any one of nSYS\_RST, VCC RESET or PCIRESET# is asserted.

In all blocks listed in [Table 5-1, "Logical Devices Reset on nSIO\\_RESET"](#), all registers within the block are reset on nSIO\_RESET except as noted in the block description.

**TABLE 5-1: LOGICAL DEVICES RESET ON NSIO\_RESET**

LPC Logical Device Number	Logical Devices
1h	8042 Keyboard Controller
7h	UART 1
8h	UART 2
Bh	Floppy Disk Controller
Ch	LPC Interface
11h	Parallel Port

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## 6.0 HOST INTERFACE

### 6.1 General Description

#### 6.1.1 OVERVIEW

The host processor communicates with the SCH5627P via the [LPC Bus Interface](#). The host processor communicates through a series of read/write registers in the SCH5627P. Register access is accomplished through programmed I/O or DMA LPC transfer cycles. All I/O transfer cycles are 8 bits wide. DMA transfer cycles can be 16-bits or 8-bits wide.

The Logical Devices located in the SCH5627P are identified in [Table 4-1, "Host Logical Devices on SCH5627P," on page 26](#). The base addresses of logical devices with registers located in LPC I/O space can be moved via the configuration registers located in the LPC Interface Configuration Register Space.

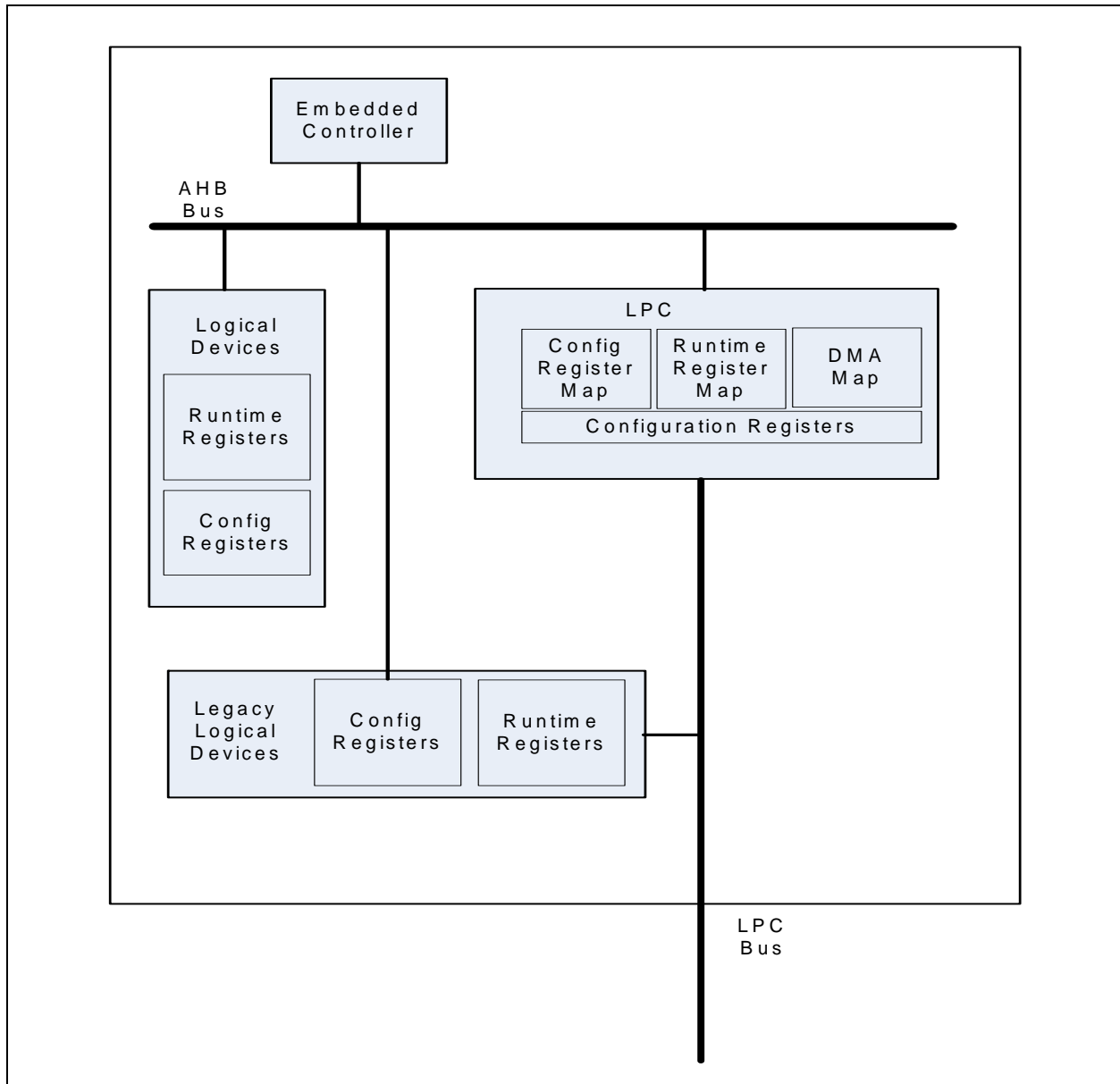
All configuration registers for the SCH5627P are accessed indirectly through the LPC I/O Configuration Register Port (IOCR-Port.) The default I/O address is 2Eh and 2Fh, but the IOCR-Port can be relocated by either the host or the EC. Detailed description of the SCH5627P Configuration Space is in [Section 7.0, "Logical Device Configuration," on page 38](#).

**TABLE 6-1: TARGETS OF LPC CYCLES CLAIMED BY THE SCH5627P**

Target	Acronym	Descriptions	LPC Types
LPC IO Configuration Register Port	<b>IOCR-Port</b>	Standard LPC 2Eh/2Fh Port which permits BIOS access. This port can be relocated by the EC or by the Host.	I/O
Logical Devices	<b>LD</b>	Targets physically located in the SCH5627P.	DMA & I/O
Configuration Register	<b>CR</b>	256 byte space per Logical Device accessed by BIOS through the IOCR-Port.	I/O through CR-Port

## 6.1.2 BLOCK DIAGRAM

**FIGURE 6-1: LPC INTERFACE IN SCH5627P**



## 6.2 Power

### 6.2.1 POWER DOMAIN

This block is powered by VTR. Although the block is not powered by VCC, the block is also controlled by PWRGD\_PS. When PWRGD\_PS is de-asserted, the LPC bus pins are placed in the same state they assume when VTR is off. LAD[3:0] and SERIRQ are tri-stated, LDRQ# is pulled high and LFRAME#, and LRESET# are gated high; see [Table 6-2, "LPC Bus Pin Behavior on Reset," on page 32](#). The LPC block is also placed in a minimal power state.

See [Section 5.9, "Registers," on page 43](#) for details on power domains.

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## 6.3 LPC Logical Device

Host accesses to [Configuration Registers](#) for each Logical Device on the SCH5627P are managed by a Configuration block described in [Section 7.0, "Logical Device Configuration,"](#) on page 38. Configuration registers are accessed through the LPC IO Configuration Register Port.

### 6.3.1 LPC BUS INTERFACE

The SCH5627P communicates with the host over a Low Pin Count (LPC) interface. The LPC interface uses 3.3V signaling. For detailed specifications, see the *Intel Low Pin Count Specification* and the *PCI Local Bus Specification*, Section 4.2.2. The LPC Bus Interface is listed in [Table 3-1, "Signal Descriptions,"](#) on page 11

The following cycle types are supported by the LPC Bus protocol.

- 8-bit I/O Read
- 8-bit I/O Write
- 8-bit DMA Read (for Logical Devices which support 8-bit DMA)
- 8-bit DMA Write (for Logical Devices which support 8-bit DMA)
- 16-bit DMA Read (for Logical Devices which support 16-bit DMA)
- 16-bit DMA Write (for Logical Devices which support 16-bit DMA)

LPC transactions that access registers located on the SCH5627P will require a minimum of two wait SYNCs on the LPC bus. The number of SYNCs may be larger if the internal bus is in use by the embedded controller, or if the data referenced by the host is not present in a SCH5627P register. The SCH5627P always uses Long Wait SYNCs, rather than Short Wait SYNCs, when responding to an LPC bus request.

[Table 6-2, "LPC Bus Pin Behavior on Reset"](#), shows the behavior of LPC outputs and input/outputs under reset conditions in accordance with the *Intel Low Pin Count Specification* and the *PCI Local Bus*.

**TABLE 6-2: LPC BUS PIN BEHAVIOR ON RESET**

Pins	VTR POR (nSYS_RST)	VCC POR	LRESET# Asserted
LAD[3:0]	Tri-state	Tri-state	Tri-State
LDRQ#	Tri-state	De-asserted (high)	De-asserted (high)
SERIRQ	Tri-state	Tri-state	Tri-State

### 6.3.2 LPC I/O CYCLES

LPC 8-bit I/O Read cycles and 8-bit I/O Write cycles are mapped directly to registers in the SCH5627P.

### 6.3.3 LPC FIRMWARE HUB AND MEMORY CYCLES

The SCH5627P does not support LPC Firmware Hub cycles and LPC Memory cycles on the LPC Bus.

### 6.3.4 DMA READ AND WRITE CYCLES

DMA read cycles involve the transfer of data from the host (main memory) to the SCH5627P. DMA write cycles involve the transfer of data from the SCH5627P to the host (main memory). Data will be coming from or going to a FIFO and will have minimal Sync times. Data transfers to/from the SCH5627P are 1 or 2 bytes.

The mechanism to configure DMA Channels on the SCH5627P is described in [Section 7.5, "DMA,"](#) on page 42 in the Configuration chapter.

See the *"Low Pin Count (LPC) Interface Specification" Reference*, Section 6.4, for the field definitions and the sequence of the DMA Read and Write cycles.

#### 6.3.4.1 DMA Protocol

DMA on the LPC bus is handled through the use of the LDRQ# lines from the SCH5627P and special encodings on LAD[3:0] from the host.

The DMA mechanism for the LPC bus is described in the "Low Pin Count (LPC) Interface Specification," Revision 1.0.



## 6.3.4.2 LDRQ# and SYNC Protocol

DMA transfers are requested through an LDRQ# assertion and ended through a SYNC field.

- Anytime a peripheral has a DMA or bus master channel that needs service, it encodes the channel number on the LDRQ# signal. There is no restriction of having to wait until the CHANNEL field is observed before encoding the next request. The only restrictions on LDRQ encoding are:
- The LDRQ# signal must be inactive for at least 1 clock before starting the next encoding.
- An LDRQ# encoding to request a transfer for a particular channel should not be attempted if one is still pending for that channel.

For single mode DMA transfers:

1. The SCH5627P will use a sync encoding of 0000 to indicate that the data is valid. No data is permitted after the first byte (for channels 0-3) or word (for channels 5-7) since it is a single transfer.
2. After the SCH5627P has observed the CHANNEL field for a particular DMA channel, it can start encoding the next request for that same channel, Requests for other channels can start at any time.

For demand mode DMA transfers:

1. The SCH5627P will use a SYNC encoding of 1001 to indicate additional transfers required. This is functionally equivalent to (and replaces) sending another LDRQ encoding for that channel.
2. The 0000 encoding is used to indicate that the data is valid but it is the last data transfer associated with that demand mode transfer. For example, on the 8<sup>th</sup> byte in a transfer (which clears a FIFO), the SCH5627P uses the 0000 encoding for SYNC. On the 1<sup>st</sup> through the 7<sup>th</sup> bytes, it uses 1001 for SYNC.
3. Once the SCH5627P has used LDRQ# to encode a request for a particular DMA channel to be active, it may not encode another active request for that channel until it has sent the 0000 encoding for SYNC to indicate no more data transfers are needed for that particular demand mode transfer for that channel.

<b>Note:</b> In 8-bit demand mode, even though the SYNC encoding used is 1001, the next cycle that comes down to the SCH5627P may not be a DMA cycle, it may be an I/O cycle.
---

See the “*Low Pin Count (LPC) Interface Specification*” Reference, Section 6.4.3 for a description of DMA request deassertion.

For back-to-back transfers from a DMA channel, the following rule applies: The SCH5627P must not assert another message for 8 LCLKs after a de-assertion is indicated through the SYNC field. This applies to transfers on the same DMA channel.

## 6.3.4.3 Flushing The FIFO

Floppy Disk Controller: Flush at the end of a sector.

Parallel Port: Flush if no data for 2 $\mu$ s.

## 6.3.4.4 DMA Arbitration

The SCH5627P does not have to arbitrate internally, even though it supports more than one DMA channel. When more than one device requests service, it sends one request out, then the other.

Arbitration for DMA channels is performed through the 8237 within the host. Once the host has won arbitration on behalf of a DMA channel. It asserts LFRAME# on the LPC bus and begins the DMA transfer.

### DMA Transfer Types

The DMA protocol is used for all transfer types, including single transfer mode, demand mode and verify mode. For demand mode, the serialized requests will be back-to-back. For verify mode transfers, the SCH5627P should drive data during the appropriate clocks; however, the host may ignore the values. A verify transfer is similar to a DMA write, where the peripheral is transferring data to main memory. The indication from the host is the same as a DMA write, so the peripheral will be driving data onto the LPC interface. However, the host will not transfer this data into main memory. The LPC interface also supports increment mode.

The LPC interface does not support DMA channels being used on cascade mode (for emulating ISA masters). The LPC interface does not support clock or decrement mode.

Channels 0-3 are 8 bit channels. Channels 5-7 are 16 bit channels.

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## 6.3.5 WAIT SYNC'S ON LPC

LPC cycles, with targets physically located in the SCH5627P, are completed with no more than **two** LPC Long WAIT SYNC's, provided the internal bus clock is configured to run at the default clock rate of 64.52MHz.

## 6.3.6 ERROR SYNC'S ON LPC

The SCH5627P does not issue ERROR SYNC cycles.

## 6.4 LPC Bus Configuration

The mapping from LPC Bus cycles to internal read/write cycles is managed by the LPC Logical Device. The mapping is defined by a series of configuration registers which are defined in [Section 7.0, "Logical Device Configuration," on page 38](#), in [Section 6.4, "LPC Bus Configuration," on page 34](#).

## 6.5 Serial Interrupts

The SCH5627P supports the serial interrupt scheme, which is adopted by several companies, to transmit interrupt information to the system. The serial interrupt scheme adheres to the *Serial IRQ Specification for PCI Systems Version 6.0*.

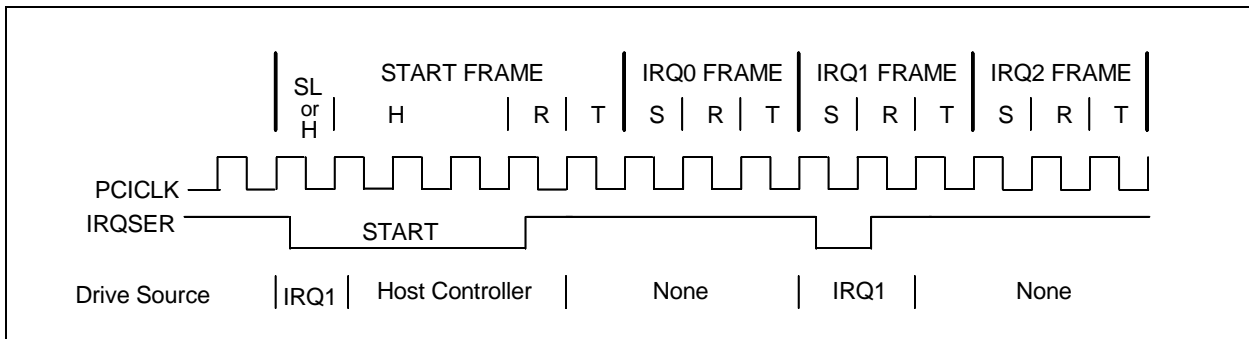
### TIMING DIAGRAMS for IRQSER CYCLE

PCICLK = 33 MHz\_IN pin

IRQSER = SIRQ pin

Start Frame timing with source sampled a low pulse on IRQ1

**FIGURE 6-2: SERIAL INTERRUPTS WAVEFORM "START FRAME"**

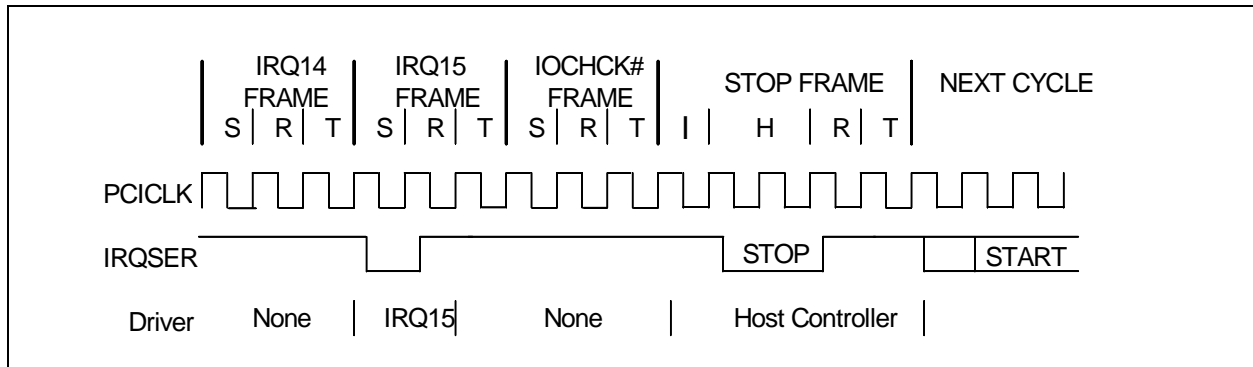


H=Host Control      SL=Slave Control      R=Recovery      T=Turn-around      S=Sample

Start Frame pulse can be 4-8 clocks wide.

Stop Frame Timing with Host using 17 IRQSER sampling period.

**FIGURE 6-3: SERIAL INTERRUPT WAVEFORM “STOP FRAME”**



H=Host Control      R=Recovery      T=Turn-around      S=Sample      I= Idle

Stop pulse is two clocks wide for Quiet mode, three clocks wide for Continuous mode.

There may be none, one, or more Idle states during the Stop Frame.

The next IRQSER cycle's Start Frame pulse may or may not start immediately after the turn-around clock of the Stop Frame.

### 6.5.1 SERIRQ MODE BIT FUNCTION

**TABLE 6-3: SERIRQ\_EN CONFIGURATION CONTROL**

CR25 Bit[2]	Name	Description
0	SERIRQ_EN	Serial IRQ Disabled
1		Serial IRQ Enabled (Default)

#### 6.5.1.1 IRQSER Cycle Control

There are two modes of operation for the IRQSER Start Frame.

##### Quiet (Active) Mode

Any device may initiate a Start Frame by driving the IRQSER low for one clock, while the IRQSER is Idle. After driving low for one clock, the IRQSER must immediately be tri-stated without at any time driving high. A Start Frame may not be initiated while the IRQSER is active. The IRQSER is Idle between Stop and Start Frames. The IRQSER is active between Start and Stop Frames. This mode of operation allows the IRQSER to be Idle when there are no IRQ/Data transitions which should be most of the time.

Once a Start Frame has been initiated, the host controller will take over driving the IRQSER low in the next clock and will continue driving the IRQSER low for a programmable period of three to seven clocks. This makes a total low pulse width of four to eight clocks. Finally, the host controller will drive the IRQSER back high for one clock then tri-state.

Any IRQSER Device (i.e., The SCH5627P) which detects any transition on an IRQ/Data line for which it is responsible must initiate a Start Frame in order to update the host controller unless the IRQSER is already in an IRQSER Cycle and the IRQ/Data transition can be delivered in that IRQSER Cycle.

##### Continuous (Idle) Mode

Only the Host controller can initiate a Start Frame to update IRQ/Data line information. All other IRQSER agents become passive and may not initiate a Start Frame. IRQSER will be driven low for four to eight clocks by host controller. This mode has two functions. It can be used to stop or idle the IRQSER or the host controller can operate IRQSER in a continuous mode by initiating a Start Frame at the end of every Stop Frame.

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An IRQSER mode transition can only occur during the Stop Frame. Upon reset, IRQSER bus is defaulted to continuous mode, therefore only the host controller can initiate the first Start Frame. Slaves must continuously sample the Stop Frames pulse width to determine the next IRQSER Cycle's mode.

## IRQSER Data Frame

Once a Start Frame has been initiated, the SCH5627P will watch for the rising edge of the Start Pulse and start counting IRQ/Data Frames from there. Each IRQ/Data Frame is three clocks: Sample phase, Recovery phase, and Turn-around phase. During the sample phase, the SCH5627P must drive the IRQSER (SIRQ pin) low, if and only if, its last detected IRQ/Data value was low. If its detected IRQ/Data value is high, IRQSER must be left tri-stated. During the recovery phase, the SCH5627P must drive the SERIRQ high, if and only if, it had driven the IRQSER low during the previous sample phase. During the turn-around phase, the SCH5627P must tri-state the SERIRQ. The SCH5627P drives the IRQSER line low at the appropriate sample point if its associated IRQ/Data line is low, regardless of which device initiated the start frame.

The Sample phase for each IRQ/Data follows the low to high transition of the Start Frame pulse by a number of clocks equal to the IRQ/Data Frame times three, minus one e.g. The IRQ5 Sample clock is the sixth IRQ/Data Frame, then the sample phase is  $\{(6 \times 3) - 1 = 17\}$  the seventeenth clock after the rising edge of the Start Pulse.

**TABLE 6-4: IRQSER SAMPLING PERIODS**

IRQSER Period	Signal Sampled	# Of Clocks Past Start
1	Not Used	2
2	IRQ1	5
3	nSMI/IRQ2	8
4	IRQ3	11
5	IRQ4	14
6	IRQ5	17
7	IRQ6	20
8	IRQ7	23
9	IRQ8	26
10	IRQ9	29
11	IRQ10	32
12	IRQ11	35
13	IRQ12	38
14	IRQ13	41
15	IRQ14	44
16	IRQ15	47

The SIRQ data frame will now support IRQ2 from a logical device; previously IRQSER Period 3 was reserved for use by the System Management Interrupt (nSMI). When using Period 3 for IRQ2, the user should mask off the SCH5627P's SMI via the ESMI Mask Register. Likewise, when using Period 3 for nSMI, the user should not configure any logical devices as using IRQ2.

IRQSER Period 14 is used to transfer IRQ13. Each Logical devices will have IRQ13 as a choice for their primary interrupt.

## Stop Cycle Control

Once all IRQ/Data Frames have completed, the host controller will terminate IRQSER activity by initiating a Stop Frame. Only the host controller can initiate the Stop Frame. A Stop Frame is indicated when the IRQSER is low for two or three clocks. If the Stop Frame's low time is two clocks, then the next IRQSER cycle's sampled mode is the Quiet mode; and any IRQSER device may initiate a Start Frame in the second clock or more after the rising edge of the Stop Frame's pulse. If the Stop Frame's low time is three clocks, then the next IRQSER cycle's sampled mode is the continuous mode, and only the host controller may initiate a Start Frame in the second clock or more after the rising edge of the Stop Frame's pulse.

## **Latency**

Latency for IRQ/Data updates over the IRQSER bus in bridge-less systems with the minimum IRQ/Data Frames of 17 will range up to 96 clocks (3.84 $\mu$ S with a 25 MHz PCI Bus or 2.88 $\mu$ s with a 33 MHz PCI Bus). If one or more PCI to PCI Bridge is added to a system, the latency for IRQ/Data updates from the secondary or tertiary buses will be a few clocks longer for synchronous buses, and approximately double for asynchronous buses.

## **EOI/ISR Read Latency**

Any serialized IRQ scheme has a potential implementation issue related to IRQ latency. IRQ latency could cause an EOI or ISR Read to precede an IRQ transition that it should have followed. This could cause a system fault. The host interrupt controller is responsible for ensuring that these latency issues are mitigated. The recommended solution is to delay EOIs and ISR Reads to the interrupt controller by the same amount as the IRQSER Cycle latency in order to ensure that these events do not occur out of order.

## **AC/DC Specification Issue**

All IRQSER agents must drive/sample IRQSER synchronously related to the rising edge of the PCI bus clock. The IRQSER (SIRQ) pin uses the electrical specification of the PCI bus. Electrical parameters will follow the PCI Specification Section 4, sustained tri-state.

## **Reset and Initialization**

The IRQSER bus uses LRESET as its reset signal and follows the PCI bus reset mechanism. The IRQSER pin is tri-stated by all agents while LRESET is active. With reset, IRQSER slaves and bridges are put into the (continuous) Idle mode. The host controller is responsible for starting the initial IRQSER cycle to collect system's IRQ/Data default values. The system then follows with the Continuous/Quiet mode protocol (Stop Frame pulse width) for subsequent IRQSER cycles. It is the host controller's responsibility to provide the default values to the 8259's and other system logic before the first IRQSER cycle is performed. For IRQSER system suspend, insertion, or removal application, the host controller should be programmed into Continuous (IDLE) mode first. This is to make sure the IRQSER bus is in Idle state before the system configuration changes.

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## 7.0 LOGICAL DEVICE CONFIGURATION

### 7.1 Description

The Configuration of the SCH5627P is very flexible and is based on the configuration architecture implemented in typical Plug-and-Play components.

The SCH5627P is designed for motherboard designs in which the resources required by their components are known. With its flexible resource allocation architecture, the SCH5627P allows the BIOS to assign resources at POST.

### 7.2 Logical Devices

Logical devices described in this section are peripherals that are located on the SCH5627P and are accessible to the Host over the LPC bus.

Each logical device on the SCH5627P can have a set of Runtime Register and a set of Configuration Registers. The distinction between Runtime and Configuration registers is that the Host can access Runtime Registers by a direct I/O address, while it can only access Configuration Registers through a configuration port. The Logical Device Numbers for the Logical Devices resident in the SCH5627P are listed in [Table 4-1, "Host Logical Devices on SCH5627P," on page 26.](#)

### 7.3 Configuration Registers

#### 7.3.1 HOST ACCESS PORT

The Host can access Configuration Registers through a port described in [Section 7.3.2, on page 38.](#) Host accesses are limited to 8 bits. There are 48 8-bit Global Configuration Registers (at offsets 00h through 2Fh), plus up to 208 8-bit registers associated with each Logical Device. The Logical Device is selected with the [Logical Device Number Register](#) (Global Configuration Register 07h). The INDEX PORT is used to select a specific logical device register. These registers are then accessed through the DATA PORT. The Logical Device registers are accessible only when the device is in the Configuration State.

Only two states are defined (Run and Configuration). In the Run State, the chip will always be ready to enter the Configuration State.

The desired configuration registers are accessed in two steps:

- Write the index of the [Logical Device Number](#) Configuration Register (i.e., 07h) to the INDEX PORT and then write the number of the desired logical device to the DATA PORT
- Write the address of the desired configuration register within the logical device to the INDEX PORT and then write or read the configuration register through the DATA PORT.

**Note 1:** If accessing the Global Configuration Registers, step (a) is not required.

- Any write to an undefined or reserved Configuration register is terminated normally on the LPC bus without any modification of state in the SCH5627P. Any read to an undefined or reserved Configuration register returns FFh.

#### 7.3.2 PRIMARY CONFIGURATION ADDRESS DECODER

The logical devices are configured through three Configuration Access Ports (CONFIG, INDEX and DATA). The BIOS uses these ports to initialize the logical devices at POST ([Table 7-1](#)).

The Base Address of the Configuration Access Ports is determined by the BAR that corresponds to Logical Device [Ch](#), the [LPC Interface](#). The Configuration Access Port BAR is unique in that an LPC I/O access that matches this BAR does not directly generate an internal read or write. Instead, the Device and Frame values in the BAR indicates that the LPC I/O should be handled locally in the LPC Logical Device. The Configuration map will issue an internal read or write, the results of which will be used to complete the LPC access.

**TABLE 7-1: SCH5627P CONFIGURATION ACCESS PORTS**

Port Name	Relative Address	Type	Port Name
CONFIG PORT	Configuration Access Ports Base Address + 0	Write	CONFIG PORT
INDEX PORT	Configuration Access Ports Base Address + 0	Read/Write	INDEX PORT
DATA PORT	Configuration Access Ports Base Address + 1		DATA PORT

## 7.3.2.1 Entering the Configuration State

The INDEX and DATA ports are effective only when the chip is in the Configuration State. The device enters the Configuration State when the Config Entry Key is successfully written to the CONFIG PORT.

**Config Entry Key = < 55h>**

## 7.3.2.2 Exiting the Configuration State

The device exits the Configuration State when the following Config Exit Key is successfully written to the CONFIG PORT address.

**Config Exit Key = < AAh>**

## 7.3.2.3 Read Accessing Configuration Port

The data read from the Configuration Port is undefined when not in the Configuration State. Writing the Config Entry Key puts the chip in the Configuration State. Once in the Configuration State, reading the Configuration Port will return the last value written to the Configuration Index. If no value was written the Configuration Port reads 00h.

## 7.3.3 CONFIGURATION SEQUENCE EXAMPLE

To program the configuration registers, the following sequence must be followed:

1. Enter Configuration State
2. Program the Configuration Registers
3. Exit Configuration State.
4. The following is an example of a configuration program in Intel 8086 assembly language.

```
;-----  
; ENTER CONFIGURATION STATE  
;-----'  
MOV    DX,CONFIG_PORT_BASE_ADDRESS  
MOV    AX,055H; Config Entry Key  
OUT    DX,AL  
  
;-----  
; CONFIGURE BASE ADDRESS, |  
; LOGICAL DEVICE 8      |  
;-----'  
MOV    DX,CONFIG_PORT_BASE_ADDRESS  
MOV    AL,07H  
OUT    DX,AL; Point to LD# Config Reg  
MOV    DX,CONFIG_PORT_BASE_ADDRESS+1  
MOV    AL, 08H  
OUT    DX,AL; Point to Logical Device 8  
;  
MOV    DX,CONFIG_PORT_BASE_ADDRESS  
MOV    AL,60H  
OUT    DX,AL ; Point to BASE ADDRESS REGISTER  
MOV    DX,CONFIG_PORT_BASE_ADDRESS+1  
MOV    AL,02H  
OUT    DX,AL ; Update BASE ADDRESS REGISTER  
;-----  
; EXIT CONFIGURATION STATE  
;-----'  
MOV    DX,CONFIG_PORT_BASE_ADDRESS  
MOV    AX,0AAH; Config Exit Key  
OUT    DX,AL.
```

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## 7.3.4 CONFIGURATION REGISTER ADDRESS MAPPING

The INDEX PORT defines 256 bytes for configuration. The first 48 of these bytes are Global Configuration registers, which reside in the first 48 bytes of the Configuration part of the address frame for Logical Device 3Fh. Values of INDEX greater than 48 map into registers that are specific to the Logical Device specified in the Global Configuration Logical Device Number Register 7h. These registers reside in upper 20 bytes of the Logical Device address frame. See [Section 7.8.2](#), on page 46 for details.

## 7.4 Configuring Runtime Register Addresses

### 7.4.1 RUNTIME REGISTERS

Runtime Registers are registers that are accessible to the Host within the Host I/O address space. These Host I/O accesses are all mapped into the SCH5627P internal address space onto devices located on the Host SPB. Runtime registers all reside within the first 256 bytes of a 1KB Logical Device address frame. The Host accesses these registers with 8-bit LPC I/O accesses. Each 8-bit I/O address is mapped into an 8-bit address in the internal address space, so the first 256 bytes of the Logical Device frame can accommodate 256 LPC Runtime Registers per Logical Device. The Host I/O addresses are determined by a block of [Base Address Registers](#) located in the LPC Logical Device. The Embedded Controller can access all the Runtime Registers as well.

### 7.4.2 BASE ADDRESS REGISTERS

Each Logical Device has a Base Address Register (BAR). . On every LPC bus I/O access all Base Address Registers are checked in parallel and if any matches the LPC I/O address the SCH5627P claims the bus cycle.

**Note:** Software should insure that no two BARs map the same LPC I/O address.

Each BAR is 32 bits wide. The format of each BAR is summarized in [Table 7-2](#), "Base Address Register Format".

**TABLE 7-2: BASE ADDRESS REGISTER FORMAT**

BYTE3 BIT	D31	D30	D29	D28	D27	D26	D25	D24
<b>BIT NAME</b>	LPC Host Address, most significant bits							
BYTE2 BIT	D23	D22	D21	D20	D19	D18	D17	D16
<b>BIT NAME</b>	LPC Host Address, least significant bits							
BYTE1 BIT	D15	D14	D13	D12	D11	D10	D9	D8
<b>BIT NAME</b>	Valid	Device	Frame					
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
<b>BIT NAME</b>	Reserved	Mask						

### MASK

These 7 bits are used to mask off address bits in the address match between an LPC I/O address and the Host Address field of the BARs, as described in [Section 7.4.3](#), "Mapping LPC I/O Addresses". A block of up to 128 8-bit registers can be assigned to one base address.

### FRAME

These 6 bits are used to specify a logical device frame number within a bus. This field is multiplied by 400h to provide the frame address within the peripheral bus address. Frame values for frames corresponding to logical devices that are not present on the SCH5627P are invalid.

### DEVICE

This bit combined with [FRAME](#) constitute the Logical Device Number. DEVICE identifies the physical location of the logical device. This bit should always be set to 0.



## VALID

If this bit is 1, the BAR is valid and will participate in LPC matches. If it is 0 this BAR is ignored.

## HOST\_ADDRESS

These 16 bits are used to match LPC I/O addresses

### 7.4.3 MAPPING LPC I/O ADDRESSES

bit A Base Address Register will match an LPC I/O address, and thus the SCH5627P will claim the LPC bus cycle, if the following relation holds:

$$(LPC\ Address \ \& \ \sim BAR.MASK) == (BAR.LPC\_Address \ \& \ \sim BAR.MASK) \ \&\& \ (BAR.Valid == 1)$$

If one of the BARs match, the LPC cycle will be claimed by the SCH5627P. The Logical Device number for the matching device is located in the Frame field of the BAR. When matching LPC I/O addresses, the SCH5627P ignores address bits that correspond to '1b' bits in the MASK field. For example, the Keyboard Controller (9042 Interface) Base Address Register has 60h in the LPC Address field, the Frame field is 01h, and the MASK field is 04h. Because of the single '1b' bit in MASK, the BAR will match LPC I/O patterns in the form '0000000011000hb', so both 60h and 64h will be matched and claimed by the SCH5627P.

As another example, if a standard 16550 UART was located at LPC I/O address 238h, then the UART Receive buffer would appear at address 238h and the Line Status register at 23Dh. If the BAR for the UART was set to 0238\_8047h, then the UART will be matched at I/O address 238h. UART1 is located in Logical Device 7h and the UART device includes 8 registers.

### 7.4.4 BASE ADDRESS REGISTER TABLE

Table 7-3, "Base Address Registers Default Values", lists the Base Address Registers for all logical devices on the SCH5627P base chip. The columns to the right of the heavy line show the field definitions for the default values listed in the column labeled "Reset Default". Shaded fields in Table 7-3 are read-only. The OFFSET column shows the index within the LPC Logical Device's Configuration register space for each BAR.

The shaded LPC I/O Address, VALID, DEVICE, FRAME, MASK fields are read-only Table 7-3. The unshaded fields has read/write access.

**TABLE 7-3: BASE ADDRESS REGISTERS DEFAULT VALUES**

Offset	Reset Default (see Note 7-1)	LPC I/O Address	Valid	Device	Frame	Masks	Description
60h	002E_0C01h	002Eh	0	0	C	1	Logical Device 0Ch: LPC Interface (Configuration Port)
64h	0000_000Fh	0000h	0	0	0	F	Logical Device 00h: EM Interface
68h	0000_0707h	0000h	0	0	7	7	Logical Device 07h: UART 1
6Ch	0000_0807h	0000h	0	0	8	7	Logical Device 08h: UART 2
70h	0000_0A3Fh	0000h	0	0	A	3F	Logical Device 0Ah: Runtime Registers
78h	0060_0000h	0060h See Note 7-3	0	0	0 See Note 7-2	0 See Note 7-2	Logical Device 01h: Keyboard Controller (8042 Interface)
7Ch	0000_0000h	0000h	0	0	0 See Note 7-2	0 See Note 7-2	Logical Device 0Bh: Floppy Disk Controller
80h	0878_8000h	0000h	1	0	0 See Note 7-2	0 See Note 7-2	Logical Device 11h: Parallel Port

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- Note 7-1** All BAR registers except the BAR at 60h (LPC Logical Device 0Ch, the LPC Interface) are reset on VTR POR, VCC RESET or LRESET. The BAR at 60h, LPC Logical Device 0Ch, is reset on VTR POR only.
- Note 7-2** The FRAME and MASK fields for these Legacy devices are not used to determine which LPC I/O addresses to claim. The address range match is maintained within the blocks themselves.
- Note 7-3** The Keyboard Controller contains registers are offset +0h, +4h (for the keyboard interface) and +32h (for legacy GateA20/KBDRST). The default BAR for the keyboard controller, set for 60h, therefore provides for the standard 60h/64h and 92h ports for keyboard control. Any address assigned to this BAR must have bit[2] and bit[5] equal to 0.

## 7.5 DMA

### 7.5.1 DMA CONFIGURATION REGISTERS

The SCH5627P will claim an LPC DMA request if the requested channel is listed as valid in the [Table 7-4, "DMA Configuration Register Map"](#). A channel is claimed if the [DMA Configuration Register Format](#) that corresponds to the channel maps to a Logical Device. In order to execute the DMA operation, the SCH5627P translates the DMA access into a bus read or write of the FIFO that corresponds to channel in question. The address of a DMA FIFO will always be one of the first 16 32-aligned addresses within the DMA quadrant of a Logical Device frame.

The mapping in the [DMA Configuration Register Map](#) is used both for mapping LPC DMA I/O requests from the Host to Logical Devices, as well as for mapping DMA requests from Logical Devices to the LPC Bus LDRQ# DMA request signal.

The Host can access the DMA Configuration registers with 8-bit accesses.

**TABLE 7-4: DMA CONFIGURATION REGISTER MAP**

Offset	Type	Reset	Configuration Register Name
50h	R/W	0000h	DMA Channel 0
52h	R/W	0000h	DMA Channel 1
54h	R/W	0000h	DMA Channel 2
56h	R/W	0000h	DMA Channel 3
58h	R	0000h	DMA Channel 4 (Reserved)
5Ah	R/W	0000h	DMA Channel 5
5Ch	R/W	0000h	DMA Channel 6
5Eh	R/W	0000h	DMA Channel 7

- Note 7-4** DMA Channel 4 is reserved in the SCH5627P. LPC Host cycles with DMA channel 4 asserted will be unclaimed by the SCH5627P.

**TABLE 7-5: DMA CONFIGURATION REGISTER FORMAT**

BYTE1 BIT	D15	D14	D13	D12	D11	D10	D9	D8
BIT NAME	Valid	Device	Frame					
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
BIT NAME	Reserved				Offset			

### OFFSET

This field should always be set to 0.

### FRAME

These 6 bits Logical Device number for the DMA target.

## DEVICE

This field should always be set to 0.

## VALID

If this bit is 1, the DMA Channel is active on the SCH5627P. If it is 0 this DMA Channel is ignored.

## 7.6 SERIRQ Interrupts

The SCH5627P can route Logical Device interrupts onto SIRQ stream frames IRQ[0:15]. Routing is controlled by the SIRQ Interrupt Configuration Registers. There is one SIRQ Interrupt Configuration Register for each accessible SIRQ Frame (IRQ); all 16 registers are listed in [Table 7-6, "SIRQ Interrupt Configuration Register Map"](#). Each SIRQ Interrupt Configuration Register controls a series of multiplexors which route to a single Logical Device interrupt as illustrated in [FIGURE 7-1: SIRQ Routing Internal Logical Devices on page 44](#). The format for each SIRQ Interrupt Configuration Register is described in [Table 7-7](#). Each Logical Device can have up to two LPC SERIRQ interrupts. When the SCH5627P is polled by the host, each SIRQ frame routes the level of the Logical Device interrupt (selected by the corresponding SIRQ Interrupt Configuration Register) to the SIRQ stream.

**Note:** Two Logical Devices cannot share a Serial IRQ.

The SIRQ Interrupt Configuration Register The Host can access the Interrupt Configuration registers with 8-bit accesses.

**Note:** A SERIRQ interrupt is deactivated by setting an entry in the [SIRQ Interrupt Configuration Register Map](#) to FFh, which is the default reset value.

### 7.6.1 SERIRQ CONFIGURATION REGISTERS

**TABLE 7-6: SIRQ INTERRUPT CONFIGURATION REGISTER MAP**

Offset	Type	Reset	Configuration Register Name
40h	R/W	FFh	IRQ0
41h	R/W	FFh	IRQ1
42h	R/W	FFh	IRQ2 (nSMI)
43h	R/W	FFh	IRQ3
44h	R/W	FFh	IRQ4
45h	R/W	FFh	IRQ5
46h	R/W	FFh	IRQ6
47h	R/W	FFh	IRQ7
48h	R/W	FFh	IRQ8
49h	R/W	FFh	IRQ9
4Ah	R/W	FFh	IRQ10
4Bh	R/W	FFh	IRQ11
4Ch	R/W	FFh	IRQ12
4Dh	R/W	FFh	IRQ13
4Eh	R/W	FFh	IRQ14
4Fh	R/W	FFh	IRQ15

**Note 7-5** The SIRQ Interrupt Configuration Registers are though the [Host Access Port](#) as 8-bit accesses. The EC can access the SIRQ Interrupt Configuration Registers as 32-bit, 16-bit across 8-bit boundary or as individual 8-bit accesses.

**TABLE 7-7: SIRQ INTERRUPT CONFIGURATION REGISTER FORMAT**

BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
BIT NAME	Select	Device	Frame					

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## FRAME

These six bits select the Logical Device for on-chip devices as the source for the interrupt.  
This field defaults to 3Fh

## DEVICE

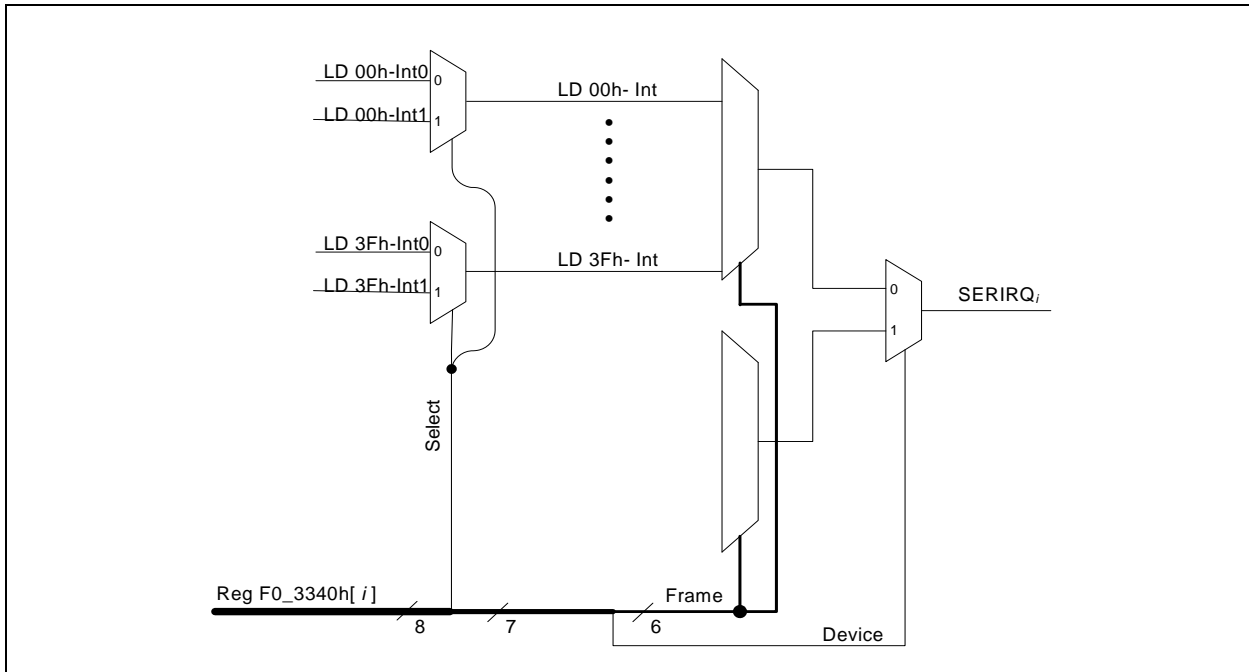
This field should always be set to 0 in order to enable a SERIRQ.

## SELECT

If this bit is 0, the first interrupt signal from the Logical Device is selected for the SERIRQ vector. If this bit is 1, the second interrupt signal from the Logical Device is selected. This field is ignored if the Logical Device has only one interrupt signal.

This field defaults to 1.

**FIGURE 7-1: SIRQ ROUTING INTERNAL LOGICAL DEVICES**



### 7.6.1.1 SIRQ Routing

**TABLE 7-8: LOGICAL DEVICE SIRQ ROUTING**

SIRQ Interrupt Configuration Register			Logical Device Interrupt Source
SELECT	DEVICE	FRAME	
0	0	0h	EMI SIRQ, Mailbox register - See <a href="#">Section 12.3, on page 135</a>
1	0	0h	EMI SIRQ, Interrupt source register - See <a href="#">Section 12.3, on page 135</a>
0	0	1h	Keyboard SIRQ - <a href="#">Section 8.5.3, on page 55</a>
1	0	1h	Mouse SIRQ - <a href="#">Section 8.5.3, on page 55</a>
0	0	7h	UART1 SIRQ - <a href="#">Section 9.3.1, on page 67</a>
0	0	8h	UART2 SIRQ - <a href="#">Section 9.3.1, on page 67</a>
0	0	Ah	PME from Runtime Registers - <a href="#">Section 16.3.15, on page 159</a>

**TABLE 7-8: LOGICAL DEVICE SIRQ ROUTING (CONTINUED)**

SIRQ Interrupt Configuration Register			Logical Device Interrupt Source
SELECT	DEVICE	FRAME	
1	0	Ah	SMI from Runtime Registers - <a href="#">Section 16.3.15, on page 159</a>
0	0	Bh	Floppy SIRQ - <a href="#">Section 11.10, on page 129</a>
0	0	11h	Parallel Port SIRQ - <a href="#">Section 10.2.13, on page 96</a>

## 7.7 Configuration Register Reset Conditions

There are two reset conditions that will cause Configuration Registers on the SCH5627P to reset to default values. A reset can be caused by a VTR Power On Reset condition (signaled by nSYS\_RST) or by an nSIO\_RESET condition. The conditions that cause nSIO\_RESET to be asserted are defined in [Section 5.7.9, "nSIO\\_RESET," on page 38](#). In addition, firmware running on the Embedded Controller can set all Configuration Registers to a default condition.

## 7.8 Logical Device Configuration/Control Registers

A separate set of control and configuration registers exist for each Logical Device and is selected with the Logical Device # Register (07h). The Logical Devices are listed in [Table 4-1, "Host Logical Devices on SCH5627P," on page 26](#), and the registers within each Logical Device are listed in [Section 7.8.2, on page 46](#).

### 7.8.1 LOGICAL DEVICE ACTIVATION

Many Logical Devices have a register, called Activate, that is used to activate the Logical Device. When a Logical Device is inactive, it is powered down. The format for the Activate Register is shown in [Table 7-9, "Activate Register"](#).

Activating a Logical Device does not cause the SCH5627P to claim LPC addresses associated with the device. Address matching for all Logical Devices is enabled or disabled in the LPC Logical Device, as described in [Section 7.4, "Configuring Runtime Register Addresses," on page 40](#).

**TABLE 7-9: ACTIVATE REGISTER**

HOST OFFSET	BYTE0: 30h						8-bit	HOST SIZE	
POWER	VTR						00b	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R	R	R	R	R	R	R	R/W	
BIT NAME	Reserved							Activate	

### Activate

When this bit is 1, the logical device is powered and functional. When this bit is 0, the logical device is powered down and inactive.

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## 7.8.2 CONFIGURATION REGISTER MAP

The SCH5627P Configuration register map is shown in Table 7-10, "SCH5627P Configuration Register Map". Logical Device numbers are in hexadecimal. All Logical Devices are accessible by both the Host and the EC. Logical Devices may be numbered between 00h and 3Fh.

**TABLE 7-10: SCH5627P CONFIGURATION REGISTER MAP**

LPC CR Index	EC Offset	Type Note 7-6	Reset Note 7-7	Configuration Register Name
<b>Configuration Registers for LDN 0h (EM Interface)</b>				
-	-	-	-	None
<b>Configuration Registers for LDN 1h (Keyboard Controller)</b>				
30h	330h	R/W	00h on nSIO_RESET	Activate
F0h	3F0h	R/W	00h on nSIO_RESET	KRST_GA20
F1	3F1h	R/W	00h on nSIO_RESET	Keyboard Select
<b>Configuration Registers for LDN 7h (UART1)</b>				
30h	330h	R/W	00h on nSYS_RST/ nSIO_RESET (see Note 7-8)	Activate Register
F0h	3F0h	R/W	00h on nSYS_RST	Configuration Select Register
<b>Configuration Registers for LDN 8h (UART2)</b>				
30h	330h	R/W	00h on nSYS_RST/ nSIO_RESET (see Note 7-8)	Activate Register
F0h	3F0h	R/W	00h on nSYS_RST	Configuration Select Register
<b>Configuration Registers for LDN Ah (Runtime Registers) (See Table 7-15, "Runtime Registers, Logical Device Ah")</b>				
F0h	3F0h	R/W	00h on nSYS_RST	SPEKEY
<b>Configuration Registers for LDN Bh (Floppy Disk Controller) (See Table 7-16, "Floppy Disk Controller, Logical Device Bh")</b>				
30h	330h	R/W	00h	Activate Register
F0h	3F0h	R/W	0Eh	FDD Mode Register
F1h	3F1h	R/W	00h	FDD Option Register
F2h	3F2h	R/W	FFh	FDD Type Register
F3h	3F3h	R	00h	Reserved
F4h	3F4h	R/W	00h	FDD0
F4h	3F5h	R/W	00h	FDD1
<b>Configuration Registers for LDN Ch (LPC Interface)</b>				
30h	330h	R/W	00h on nSIO_RESET	Activate Register
40h	340h	R/W	FFh on nSIO_RESET	SIRQ IRQ0 Configuration Register
41h	341h	R/W	FFh on nSIO_RESET	SIRQ IRQ1 Configuration Register
42h	342h	R/W	FFh on nSIO_RESET	SIRQ IRQ2 (nSMI) Configuration Register
43h	343h	R/W	FFh on nSIO_RESET	SIRQ IRQ3 Configuration Register
44h	344h	R/W	FFh on nSIO_RESET	SIRQ IRQ4 Configuration Register
45h	345h	R/W	FFh on nSIO_RESET	SIRQ IRQ5 Configuration Register
46h	346h	R/W	FFh on nSIO_RESET	SIRQ IRQ6 Configuration Register
47h	347h	R/W	FFh on nSIO_RESET	SIRQ IRQ7 Configuration Register

**TABLE 7-10: SCH5627P CONFIGURATION REGISTER MAP (CONTINUED)**

LPC CR Index	EC Offset	Type Note 7-6	Reset Note 7-7	Configuration Register Name
48h	348h	R/W	FFh on nSIO_RESET	SIRQ IRQ8 Configuration Register
49h	349h	R/W	FFh on nSIO_RESET	SIRQ IRQ9 Configuration Register
4Ah	34Ah	R/W	FFh on nSIO_RESET	SIRQ IRQ10 Configuration Register
4Bh	34Bh	R/W	FFh on nSIO_RESET	SIRQ IRQ11 Configuration Register
4Ch	34Ch	R/W	FFh on nSIO_RESET	SIRQ IRQ12 Configuration Register
4Dh	34Dh	R/W	FFh on nSIO_RESET	SIRQ IRQ13 Configuration Register
4Eh	34Eh	R/W	FFh on nSIO_RESET	SIRQ IRQ14 Configuration Register
4Fh	34Fh	R/W	FFh on nSIO_RESET	SIRQ IRQ15 Configuration Register
50h	350h	R/W	00h on nSIO_RESET	DMA Channel 0, LSB Configuration Register
51h	351h	R/W	00h on nSIO_RESET	DMA Channel 0, MSB Configuration Register
52h	352h	R/W	00h on nSIO_RESET	DMA Channel 1, LSB Configuration Register
53h	353h	R/W	00h on nSIO_RESET	DMA Channel 1, MSB Configuration Register
54h	354h	R/W	00h on nSIO_RESET	DMA Channel 2, LSB Configuration Register
55h	355h	R/W	00h on nSIO_RESET	DMA Channel 2 MSB Configuration Register
56h	356h	R/W	00h on nSIO_RESET	DMA Channel 3, LSB Configuration Register
57h	357h	R/W	00h on nSIO_RESET	DMA Channel 3, MSB Configuration Register
58h	358h	R/W	00h on nSIO_RESET	DMA Channel 4, LSB Configuration Register
59h	359h	R/W	00h on nSIO_RESET	DMA Channel 4 MSB Configuration Register
5Ah	35Ah	R/W	00h on nSIO_RESET	DMA Channel 5, LSB Configuration Register
5Bh	35Bh	R/W	00h on nSIO_RESET	DMA Channel 5, MSB Configuration Register
5Ch	35Ch	R/W	00h on nSIO_RESET	DMA Channel 6, LSB Configuration Register
5Dh	35Dh	R/W	00h on nSIO_RESET	DMA Channel 6, MSB Configuration Register
5Eh	35Eh	R/W	00h on nSIO_RESET	DMA Channel 7, LSB Configuration Register
5Fh	35Fh	R/W	00h on nSIO_RESET	DMA Channel 7, MSB Configuration Register
60h - 63h	360h	R/W / R	002E_0C01h on nSYS_RST n nSIO_RESET	BAR for Configuration Port
64h - 67h	364h	R/W / R	0000_000Fh on nSIO_RESET	BAR for EMI
68h - 6Bh	368h	R/W / R	0000_0707h on nSIO_RESET	BAR for UART1
6C - 6F	36Ch	R/W / R	0000_0807h on nSIO_RESET	BAR for UART2
70h - 73h	370h	R/W / R	0000_0A3Fh on nSIO_RESET	BAR for Runtime Registers
78h - 7Bh	378h	R/W / R	0060_0000h on nSIO_RESET	BAR for 8042
7Ch - 7Fh	37Ch	R/W / R	0000_0000h on nSIO_RESET	BAR for Floppy Disk Controller
80h - 83h	380h	R/W / R	0878_8000h on nSIO_RESET	BAR for Parallel Port
<b>Configuration Registers for LDN 11h (Parallel Port) (See Table 7-17, "Parallel Port, Logical Device 11h")</b>				
30h	330h	R/W	00h	Activate Register
F0h	3F0h	R/W	3Ch	PP Mode Register

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**TABLE 7-10: SCH5627P CONFIGURATION REGISTER MAP (CONTINUED)**

LPC CR Index	EC Offset	Type Note 7-6	Reset Note 7-7	Configuration Register Name
F1h	3F1h	R/W	00h	PP Mode Register 2
<b>Configuration Registers for LDN 3Fh (Global Configuration)</b>				
00h - 02h	300h - 302h	-		Reserved
03H	303	-	-	MCHP Reserved
04h - 06h	304h - 306h	-	00h on <a href="#">nSIO_RESET</a>	Reserved
<a href="#">07h</a>	307h	R/W	-	<a href="#">Logical Device Number</a>
08h - 1Fh	308h-31Fh	-		Reserved
<a href="#">20h</a>	320h	R	C6h	<a href="#">Device ID</a>
<a href="#">21h</a>	321h	R	Current Revision hardwired	<a href="#">Device Revision</a> A read-only register which provides device revision information
22h- 23h	322h-323h	-	04h on <a href="#">nSIO_RESET</a>	MCHP Reserved
<a href="#">24h</a>	324h	R/W	00h	<a href="#">Device Mode</a>
25h - 2Fh	325h-32Fh	-		MCHP Reserved

**Note 7-6** R/W / R means that some parts of a register are read/write and some parts are read-only.

**Note 7-7** Resets are defined in [Section 5.0, "Power, Clocks and Resets"](#): [nSYS\\_RST](#) on [page 37](#) and [nSIO\\_RESET](#) on [page 38](#).

**Note 7-8** The Activate register is reset on [nSYS\\_RST](#) if the Power bit in the [Configuration Select Register](#) is 0. It is reset on [nSIO\\_RESET](#) if the Power bit in the [Configuration Select Register](#) is 1.

## 7.9 Chip-Level (Global) Control/Configuration Registers

As with all Configuration Registers, the INDEX PORT is used to select a Global Configuration Register in the chip. The DATA PORT is then used to access the selected register.

The Host can access all the Global Configuration registers at the offsets listed in [Table 7-11, "Chip-Level \(Global\) Control/Configuration Registers"](#) through the INDEX PORT and the DATA PORT.

**TABLE 7-11: CHIP-LEVEL (GLOBAL) CONTROL/CONFIGURATION REGISTERS**

Register	Offset	Description
<b>CHIP (GLOBAL) CONTROL REGISTERS</b>		
Reserved	00h - 06h	Reserved - Writes are ignored, reads return 0.
Logical Device Number	07h	A write to this register selects the current logical device. This allows access to the control and configuration registers for each logical device. <b>Note:</b> The Activate command operates only on the selected logical device.
Reserved	08h - 1Fh	Reserved - Writes are ignored, reads return 0.
Device ID	20h	A read-only register which provides device identification: Bits[7:0] = C6h
Device Revision Hard Wired	21h	A read-only register which provides device revision information. Bits[7:0] = current revision when read
Reserved	22h - 23h	Reserved - Writes are ignored, reads return 0.



**TABLE 7-11: CHIP-LEVEL (GLOBAL) CONTROL/CONFIGURATION REGISTERS (CONTINUED)**

Register	Offset	Description
Device Mode	24h	Bit [1:0] Reserved – writes ignored, reads return “0”. Bit[2] SerIRQ Mode) = 0: Serial IRQ Disabled. = 1: Serial IRQ Enabled (Default). Bit [7:3] Reserved – writes ignored, reads return “0”.
Reserved	25h - 27h	Reserved - Writes are ignored, reads return 0.
Test Register	28h	MCHP Test Mode Register, Reserved for Microchip
Test Register	29h	MCHP Test Mode Register, Reserved for Microchip
Reserved	2Ah - 2Bh	Reserved - Writes are ignored, reads return 0.
Test Register	2Ch	MCHP Test Mode Register, Reserved for Microchip
Test Register	2Dh	MCHP Test Mode Register, Reserved for Microchip
Test Register	2Eh	MCHP Test Mode Register, Reserved for Microchip
Test Register	2Fh	MCHP Test Mode Register, Reserved for Microchip

## 7.10 Microchip-Defined Logical Device Configuration Registers

Host logical devices not listed have no Microchip-defined configuration registers.

**TABLE 7-12: KEYBOARD CONTROLLER, LOGICAL DEVICE 1H**

Name	REG Index	Definition
KRST_GA20 Default = 00h on nSIO_RESET  Bits[6:5] reset on nSYS_RST only	F0h R/W	KRESET and GateA20 Select Bit[7] Reserved Bit[6] M_ISO. Enables/disables isolation of mouse signals into 8042. Does not affect MDAT signal to mouse wakeup (PME) logic. 1 = block mouse clock and data signals into 8042 0 = do not block mouse clock and data signals into 8042 Bit[5] K_ISO. Enables/disables isolation of keyboard signals into 8042. Does not affect KDAT signal to keyboard wakeup (PME) logic. 1 = block keyboard clock and data signals into 8042 0 = do not block keyboard clock and data signals into 8042 Bit[4] MLATCH = 0 MINT is the 8042 MINT ANDed with Latched MINT (default) = 1 MINT is the latched 8042 MINT Bit[3] KLATCH = 0 KINT is the 8042 KINT ANDed with Latched KINT (default) = 1 KINT is the latched 8042 KINT Bit[2] Port 92 Select = 0 Port 92 Disabled (default) = 1 Port 92 Enabled Bit[1] MCHP Reserved. Must be written with a 0. Bit[0] MCHP Reserved. Must be written with a 0.  See <a href="#">Note 7-9</a>
Keyboard Select Default = 00h on on nSIO_RESET	F1h R/W	Bit[0] Kbd/mouse Swap. This bit is used to swap the keyboard and mouse clock and data pins into/out of the 8042 as follows: 1 = internally swap the KCLK pin and the MCLK pin, and the KDAT pin and the MDAT pin into/out of the 8042. 0 = do not swap the keyboard and mouse clock and data pins  Bit[1] MCHP Reserved. Must be written with a 0.  Bit[7:2] reserved  See <a href="#">Note 7-9</a>
8042 Reset Default = 00h on nSIO_RESET	F2h R/W	Bit[0] 8042 Reset. 1 = Put the 8042 into reset 0 = Take the 8042 out of reset Bit[7:1] Reserved

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**Note 7-9** Wake on Specific Key and general Keyboard and Mouse PME events are unaffected by the M\_ISO, K\_ISO, KBD/MOUSE SWAP functions of the keyboard logical device configuration registers.

**TABLE 7-13: SERIAL PORT 1, LOGICAL DEVICE 7**

Name	REG Index	Definition
Serial Port 1 Configuration Select Register  Default = 00h on nSYS_RST	F0 (R/W)	Bit[0] CLK SRC = 0 1.8432MHz clock source from 64.52MHz ring oscillator (default) = 1 1.8432MHz clock sourced from 96MHz PLL  Bit[1] Power = 0 UART runtime registers controlled by VTR, reset on nSYS_RST (default) = 1 UART runtime registers controlled by VCC, reset on nSIO_RESET  Bit[2] Polarity = 0 TX and RX pins are not inverted (default) = 1 TX and RX pins are inverted  Bit[7:3] Reserved, set to zero

**TABLE 7-14: SERIAL PORT 2, LOGICAL DEVICE 8**

Name	REG Index	Definition
Serial Port 2 Configuration Select Register  Default = 00h on nSYS_RST	F0 (R/W)	Bit[0] CLK SRC = 0 1.8432MHz clock source from 64.52MHz ring oscillator (default) = 1 1.8432MHz clock sourced from 96MHz PLL  Bit[1] Power = 0 UART runtime registers controlled by VTR, reset on nSYS_RST (default) = 1 UART runtime registers controlled by VCC, reset on nSIO_RESET  Bit[2] Polarity = 0 TX and RX pins are not inverted (default) = 1 TX and RX pins are inverted  Bit[7:3] Reserved, set to zero

**TABLE 7-15: RUNTIME REGISTERS, LOGICAL DEVICE AH**

Name	REG Index	Definition
SPEKEY  Default = 00h on nSIO_RESET	F0h (R/W)	Bit[0] Reserved – returns a '0' when read. Bit[1] SPEKEY_EN. This bit is used to turn the logic for the “wake on specific key” feature on and off. It will disable the clock input to the logic when turned off. The logic will draw no power when disabled. 0 = “Wake on specific key” logic is on (default) 1 = “Wake on specific key” logic is off Bits[7:2] are reserved

**TABLE 7-16: FLOPPY DISK CONTROLLER, LOGICAL DEVICE BH**

Name	REG Index	Definition
FDD Mode Register Default = 0Eh on nSIO_RESET	F0h (R/W)	Bit[0] Floppy Mode = 0 Normal Floppy Mode (default) = 1 Enhanced Floppy Mode 2 (OS2) Bit[1] FDC DMA Mode = 0 Burst Mode is enabled = 1 Non-Burst Mode (default) Bit[3:2] Interface Mode = 11 AT Mode (default) = 10 (Reserved) = 01 PS/2 = 00 Model 30 Bit[4] Reserved Bit[5] Reserved, set to zero Bit[6] FDC Output Type Control = 0 FDC outputs are OD12 open drain (default) = 1 FDC outputs are O12 push-pull Bit[7] FDC Output Control = 0 FDC outputs active (default) = 1 FDC outputs tri-stated
FDD Option Register Default = 00h on nSIO_RESET	F1h (R/W)	Bit[0] Forced Write Protect = 0 Inactive (default) = 1 FDD WRTprt# input is forced active when either of the drives has been selected.  WRTprt# (to the FDC Core) = WP (FDC SRA register, bit 1) = (DS0# AND Forced Write Protect) OR WRTprt# (from the FDD Interface) OR Floppy Write Protect <b>Notes:</b> <ul style="list-style-type: none"> <li>The Floppy Write Protect bit is in the Device Disable register.</li> <li>Boot floppy is always drive 0.</li> </ul> Bit[1] Reserved Bits[3:2] Density Select = 00 Normal (default) = 01 Normal (reserved for users) = 10 1 (forced to logic "1") = 11 0 (forced to logic "0") Bit[7:4] Reserved.
FDD Type Register Default = 0xFF on nSIO_RESET	F2h (R/W)	Bits[1:0] Floppy Drive A Type Bits[3:2] Reserved (could be used to store Floppy Drive B type) Bits[5:4] Reserved (could be used to store Floppy Drive C type) Bits[7:6] Reserved (could be used to store Floppy Drive D type)
	F3h (R)	Reserved, Read as 0 (read only)
FDD0 Default = 00h on nSIO_RESET	F4h (R/W)	Bits[1:0] Drive Type Select: DT1, DT0 Bit[2] Read as 0 (read only) Bit[3] Data Rate Table Select: DRT0 Bit[4] MCHP Reserved. Must be written as 0 Bits[5] Read as 0 (read only) Bits[6] Precompensation Disable PTS = 0 Use Precompensation = 1 No Precompensation Bits[7] Read as 0 (read only)
	F5h (R/W)	MCHP Reserved

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**TABLE 7-17: PARALLEL PORT, LOGICAL DEVICE 11H**

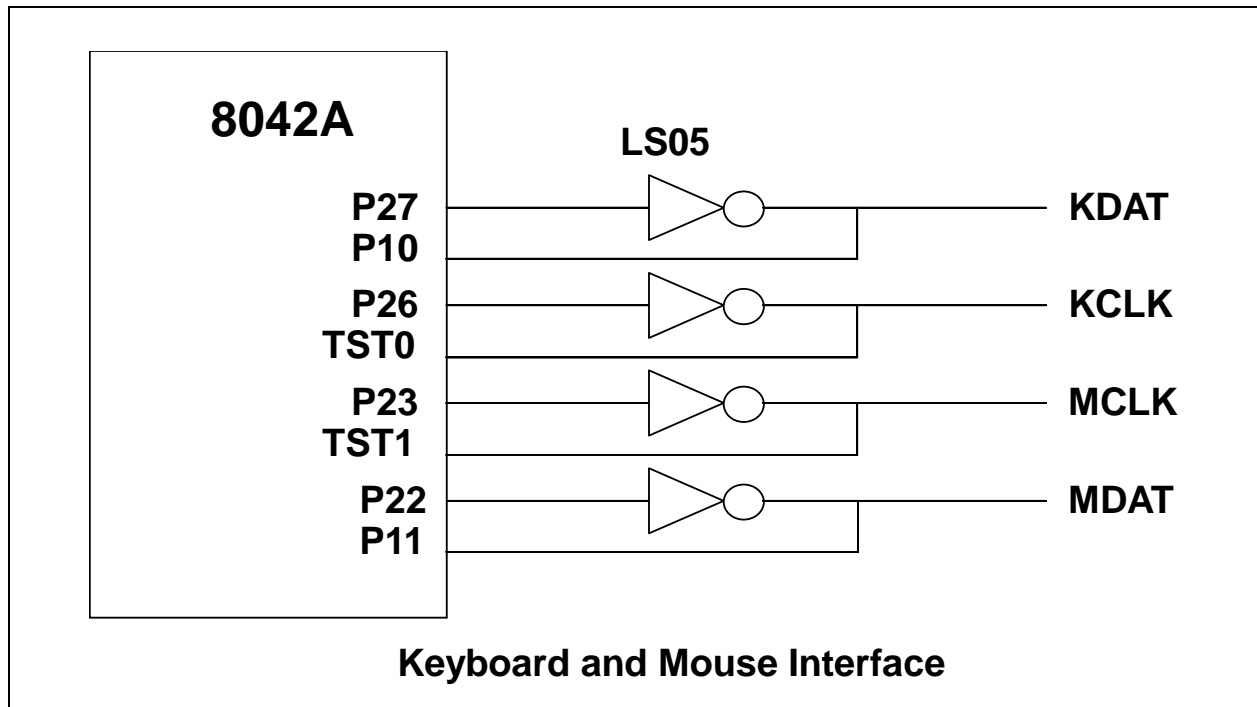
Name	REG Index	Definition
Interrupt Select  Default = 0x00 on nSIO_RESET	70h	Bits[7:4] Reserved, set to zero. Bit[3:0] SERIRQ Channel The contents of this register is <b>only</b> used as a source for the Parallel Port IRQ field in the cnfgB Extended Parallel Port register. It does not affect the SERIRQ channel on which Parallel Port interrupts appear. If use of the cnfgB register is required, this register should be programmed with the channel number assigned to the Parallel Port in the LPC Logical Device, as shown in <a href="#">Table 7-6, "SIRQ Interrupt Configuration Register Map"</a> . If cnfgB is not required, then this register may be left in its default state.
DMA Channel Select  Default = 0x00 on nSIO_RESET	74h	Bits[7:3] Reserved, set to zero. Bit[2:0] DMA Channel The contents of this register is <b>only</b> used as a source for the Parallel Port DMA field in the cnfgB Extended Parallel Port register. It does not affect the DMA channel on which Parallel Port transfers appear. If use of the cnfgB register is required, this register should be programmed with the channel number assigned to the Parallel Port in the LPC Logical Device, as shown in <a href="#">Table 7-4, "DMA Configuration Register Map"</a> . If cnfgB is not required, then this register may be left in its default state.
PP Mode Register  Default = 3Ch on nSIO_RESET	F0h (R/W)	Bits[2:0] Parallel Port Mode = 100 Printer Mode (default) = 000 Standard and Bi-directional (SPP) Mode = 001 EPP-1.9 and SPP Mode = 101 EPP-1.7 and SPP Mode = 010 ECP Mode = 011 ECP and EPP-1.9 Mode = 111 ECP and EPP-1.7 Mode  Bit[6:3] ECP FIFO Threshold 0111b (default)  Bit[7] PP Interrupt Type Not valid when the parallel port is in the Printer Mode (100) or the Standard & Bi-directional Mode (000). = 1 Pulsed Low, released to high-Z. = 0 IRQ follows ACK# when parallel port in EPP Mode or [Printer, SPP, EPP] under ECP.  IRQ level type when the parallel port is in ECP, TEST, or Centronics FIFO Mode.
PP Mode Register 2  Default = 00h on nSIO_RESET	F1h (R/W)	Bits[3:0] Reserved. Set to zero Bit [4] TIMEOUT_SELECT = 0 TMOUT (EPP Status Reg.) cleared on write of '1' to TMOUT. = 1 TMOUT cleared on trailing edge of read of EPP Status Reg. Bits[7:5] Reserved. Set to zero.

## 8.0 KEYBOARD CONTROLLER

### 8.1 General Description

The SCH5627P is a Super I/O and Universal Keyboard Controller that is designed for intelligent keyboard management in desktop computer applications. The Universal Keyboard Controller uses an 8042 microcontroller CPU core. This section concentrates on the SCH5627P enhancements to the 8042. For general information about the 8042, refer to the "Hardware Description of the 8042" in the *8-Bit Embedded Controller Handbook*.

**FIGURE 8-1: SCH5627P KEYBOARD AND MOUSE INTERFACE**



KIRQ is the Keyboard IRQ.

MIRQ is the Mouse IRQ.

Port 21 is used to create a GATEA20 signal from the SCH5627P.

### 8.2 Power, Clocks and Reset

#### 8.2.1 POWER DOMAIN

This block is powered by the VTR power supply.

#### 8.2.2 CLOCKS

This block uses a 12MHz clock derived from the 96MHz PLL, as well as the Host Bus Clock when the Configuration registers are accessed.

#### 8.2.3 RESET

This block is reset when nSIO\_RESET is asserted.

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## 8.3 Interrupts

The Keyboard Interface can generate two Serial Interrupt Requests on the LPC bus. Each can be put on any of the SERIRQ channels as configured by the SERIRQ configuration registers in the LPC host interface block. A Keyboard interrupt is the Primary interrupt (chosen when the SELECT field in the LPC SERIRQ configuration register is 0) and a mouse interrupt is the secondary interrupt (chosen when the SELECT field is 1).

The Keyboard interrupt and Mouse interrupt signals are also routed to [GIRQ15](#), as the KBC\_KIRQ and KBC\_MIRQ bits, so the EC may also respond to keyboard controller interrupts.

## 8.4 Keyboard Interface

The SCH5627P LPC interface is functionally compatible with the 8042 style host interface. It consists of the D0-7 data signals; the read and write signals and the Status register, Input Data register, and Output Data register. [Table 8-1](#) shows how the interface decodes the control signals. In addition to the above signals, the host interface includes keyboard and mouse IRQs.

**TABLE 8-1: I/O ADDRESS MAP**

Address	Command	Block	Function (Note:)
60h	Write	KDATA	Keyboard Data Write (C/D=0)
	Read	KDATA	Keyboard Data Read
64h	Write	KDCTL	Keyboard Command Write (C/D=1)
	Read	KDCTL	Keyboard Status Read

**Note:** These registers consist of three separate 8-bit registers. Status, Data/Command Write and Data Read.

### Keyboard Data Write

bit This is an 8 bit write only register. When written, the C/D status bit of the status register is cleared to zero and the IBF bit is set.

### Keyboard Data Read

This is an 8 bit read only register. If enabled by "ENABLE FLAGS", when read, the KIRQ output is cleared and the OBF flag in the status register is cleared. If not enabled, the KIRQ and/or AUXOBF1 must be cleared in software.

### Keyboard Command Write

This is an 8 bit write only register. When written, the C/D status bit of the status register is set to one and the IBF bit is set.

### Keyboard Status Read

This is an 8 bit read only register. Refer to the description of the Status Register for more information.

### CPU-to-Host Communication

The SCH5627P CPU can write to the Output Data register via register DBB. A write to this register automatically sets Bit 0 (OBF) in the Status register. See [Table 8-2](#).

**TABLE 8-2: HOST INTERFACE FLAGS**

8042 INSTRUCTION	FLAG
OUT DBB	Set OBF, and, if enabled, the KIRQ output signal goes high

### Host-to-CPU Communication

The host system can send both commands and data to the Input Data register. The CPU differentiates between commands and data by reading the value of Bit 3 of the Status register. When bit 3 is "1", the CPU interprets the register contents as a command. When bit 3 is "0", the CPU interprets the register contents as data. During a host write operation, bit 3 is set to "1" if SA2 = 1 or reset to "0" if SA2 = 0.

## KIRQ

If “EN FLAGS” has been executed and P24 is set to a one: the OBF flag is gated onto KIRQ. The KIRQ signal can be connected to system interrupt to signify that the SCH5627P CPU has written to the output data register via “OUT DBB,A”. If P24 is set to a zero, KIRQ is forced low. On power-up, after a valid RST pulse has been delivered to the device, KIRQ is reset to 0. KIRQ will normally reflect the status of writes “DBB”. (KIRQ is normally selected as IRQ1 for keyboard support.)

If “EN FLAGS” has not been executed: KIRQ can be controlled by writing to P24. Writing a zero to P24 forces KIRQ low; a high forces KIRQ high.

## MIRQ

If “EN FLAGS” has been executed and P25 is set to a one; IBF is inverted and gated onto MIRQ. The MIRQ signal can be connected to system interrupt to signify that the SCH5627P CPU has read the DBB register. If “EN FLAGS” has not been executed, MIRQ is controlled by P25, Writing a zero to P25 forces MIRQ low, a high forces MIRQ high. (MIRQ is normally selected as IRQ12 for mouse support).

## Gate A20

A general purpose P21 is used as a software controlled Gate A20 or user defined output.

## 8.5 External Keyboard and Mouse Interface

bit Industry-standard PC-AT-compatible keyboards employ a two-wire, bidirectional TTL interface for data transmission. Several sources also supply PS/2 mouse products that employ the same type of interface. To facilitate system expansion, the SCH5627P provides four signal pins that may be used to implement this interface directly for an external keyboard and mouse.

bit The SCH5627P has four high-drive, open-drain output, bidirectional port pins that can be used for external serial interfaces, such as external keyboard and PS/2-type mouse interfaces. They are KCLK, KDAT, MCLK, and MDAT. P26 is inverted and output as KCLK. The KCLK pin is connected to TEST0. P27 is inverted and output as KDAT. The KDAT pin is connected to P10. P23 is inverted and output as MCLK. The MCLK pin is connected to TEST1. P22 is inverted and output as MDAT. The MDAT pin is connected to P11.

**Note:** External pull-ups may be required.

### 8.5.1 KEYBOARD/MOUSE SWAP BIT

There is a Kbd/mouse Swap bit in the Keyboard Select configuration register located at F1h in Logical Device 1. This bit can be used to swap the keyboard and mouse clock and data pins into/out of the 8042. The default value of this bit is ‘0’ on VCC RESET, VTR POR and PCI Reset. This bit is defined as follows:

1 = internally swap the KCLK pin and the MCLK pin, and the KDAT pin and the MDAT pin into/out of the 8042.

0 = do not swap the keyboard and mouse clock and data pins

### 8.5.2 KEYBOARD POWER MANAGEMENT

The keyboard provides support for two power-saving modes: soft power-down mode and hard power-down mode. In soft power-down mode, the clock to the ALU is stopped but the timer/counter and interrupts are still active. In hard power down mode the clock to the 8042 is stopped.

#### Soft Power-Down Mode

This mode is entered by executing a HALT instruction. The execution of program code is halted until either RESET is driven active or a data byte is written to the DBBIN register by a master CPU. If this mode is exited using the interrupt, and the IBF interrupt is enabled, then program execution resumes with a CALL to the interrupt routine, otherwise the next instruction is executed. If it is exited using RESET then a normal reset sequence is initiated and program execution starts from program memory location 0.

#### Hard Power-Down Mode

This mode is entered by executing a STOP instruction. The oscillator is stopped by disabling the oscillator driver cell. When either RESET is driven active or a data byte is written to the DBBIN register by a master CPU, this mode will be exited (as above). However, as the oscillator cell will require an initialization time, either RESET must be held active for sufficient time to allow the oscillator to stabilize. Program execution will resume as above.

### 8.5.3 INTERRUPTS

The SCH5627P provides the two 8042 interrupts: IBF and the Timer/Counter Overflow.

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## 8.5.4 MEMORY CONFIGURATIONS

The SCH5627P provides 2K of on-chip ROM and 256 bytes of on-chip RAM.

## 8.5.5 REGISTER DEFINITIONS

### Host I/F Data Register

The Input Data register and Output Data register are each 8 bits wide. A write to this 8 bit register will load the Keyboard Data Read Buffer, set the OBF flag and set the KIRQ output if enabled. A read of this register will read the data from the Keyboard Data or Command Write Buffer and clear the IBF flag. Refer to the KIRQ and Status register descriptions for more information.

### Host I/F Status Register

The Status register is 8 bits wide.

Table 8-3 shows the contents of the Status register.

**TABLE 8-3: STATUS REGISTER**

D7	D6	D5	D4	D3	D2	D1	D0
UD	UD	UD	UD	C/D	UD	IBF	OBF

### Status Register

This register is cleared on a reset. This register is read-only for the Host and read/write by the SCH5627P CPU.

UD Writable by SCH5627P CPU. These bits are user-definable.

C/D (Command Data)-This bit specifies whether the input data register contains data or a command (0 = data, 1 = command). During a host data/command write operation, this bit is set to "1" if SA2 = 1 or reset to "0" if SA2 = 0.

IBF (Input Buffer Full)- This flag is set to 1 whenever the host system writes data into the input data register. Setting this flag activates the SCH5627P CPU's nIBF (MIRQ) interrupt if enabled. When the SCH5627P CPU reads the input data register (DBB), this bit is automatically reset and the interrupt is cleared. There is no output pin associated with this internal signal.

OBF (Output Buffer Full) - This flag is set to whenever the SCH5627P CPU write to the output data register (DBB). When the host system reads the output data register, this bit is automatically reset.

## 8.5.6 EXTERNAL CLOCK SIGNAL

The SCH5627P Keyboard Controller clock source is a 12 MHz clock generated from the internal 96MHz PLL. The reset pulse must last for at least 24 16 MHz clock periods. The pulse-width requirement applies to both internally (VCC RESET) and externally generated reset signals. In power-down mode, the external clock signal is not loaded by the chip.

## 8.5.7 DEFAULT RESET CONDITIONS

The SCH5627P has one source of hardware reset for the keyboard controller: an external reset via the LRESET# pin. Refer to Table 8-4 for the effect of each type of reset on the internal registers.

**TABLE 8-4: RESETS**

Description	Hardware Reset (LRESET#)
KCLK	Low
KDAT	Low
MCLK	Low
MDAT	Low
Host I/F Data Reg	N/A
Host I/F Status Reg	00H
<b>Note:</b> N/A = Not Applicable	

### 8.5.7.1 GATEA20 and Keyboard Reset

The SCH5627P provides two options for GateA20 and Keyboard Reset: 8042 Software Generated GateA20 and KRESET and Port 92 Fast GateA20 and KRESET.



## 8.5.7.2 Port 92 Fast GATEA20 and Keyboard Reset

### Port 92 Register

This port can only be read or written if Port 92 has been enabled via bit 2 of the KRST\_GA20 Register (Logical Device 1, F0h) set to 1.

This register is used to support the alternate reset (nALT\_RST) and alternate A20 (ALT\_A20) functions.

Name	Port 92
Location	92h
Default Value	24h
Attribute	Read/Write
Size	8 bits

**TABLE 8-5: PORT 92 REGISTER**

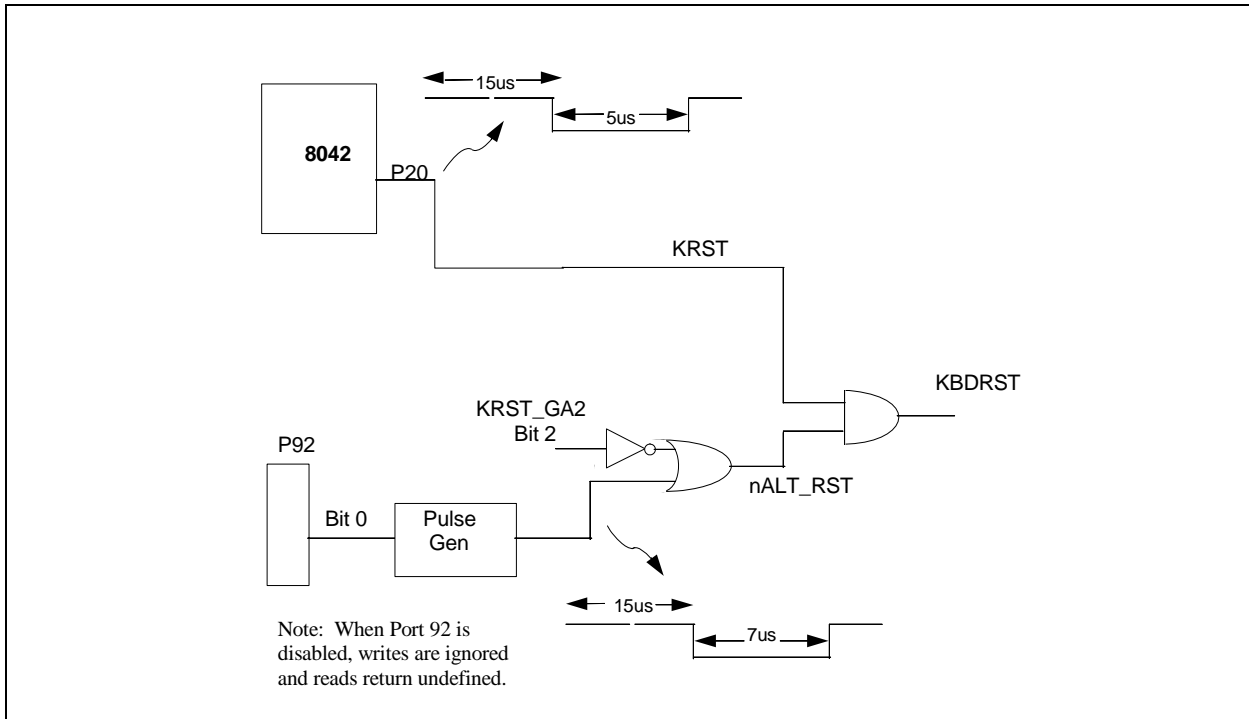
Bit	Function
7:6	Reserved. Returns 00 when read
5	Reserved. Returns a 1 when read
4	Reserved. Returns a 0 when read
3	Reserved. Returns a 0 when read
2	Reserved. Returns a 1 when read
1	ALT_A20 Signal control. Writing a 0 to this bit causes the ALT_A20 signal to be driven low. Writing a 1 to this bit causes the ALT_A20 signal to be driven high.
0	Alternate System Reset. This read/write bit provides an alternate system reset function. This function provides an alternate means to reset the system CPU to effect a mode switch from Protected Virtual Address Mode to the Real Address Mode. This provides a faster means of reset than is provided by the Keyboard controller. This bit is set to a 0 by a system reset. Writing a 1 to this bit will cause the nALT_RST signal to pulse active (low) for a minimum of 1 $\mu$ s after a delay of 500 ns. Before another nALT_RST pulse can be generated, this bit must be written back to a 0.

NGATEA20		
8042 P21	ALT_A20	System NA20M
0	0	0
0	1	1
1	0	1
1	1	1

Bit 0 of Port 92, which generates the nALT\_RST signal, is used to reset the CPU under program control. This signal is AND'ed together externally with the reset signal (KBDRST#) from the keyboard controller to provide a software means of resetting the CPU. This provides a faster means of reset than is provided by the keyboard controller. Writing a 1 to bit 0 in the Port 92 Register causes this signal to pulse low for a minimum of 7 $\mu$ s, after a delay of a minimum of 15 $\mu$ s. Before another nALT\_RST pulse can be generated, bit 0 must be set to 0 either by a system reset or a write to Port 92. Upon reset, this signal is driven inactive high (bit 0 in the Port 92 Register is set to 0).

If Port 92 is enabled, i.e., bit 2 of KRST\_GA20 is set to 1, then a pulse is generated by writing a 1 to bit 0 of the Port 92 Register and this pulse is AND'ed with the pulse generated from the 8042. This pulse is output on pin KRESET and its polarity is controlled by the GPI/O polarity configuration.

**FIGURE 8-2: KBRST IMPLEMENTATION**



Bit 1 of Port 92, the ALT\_A20 signal, is used to force nA20M to the CPU low for support of real mode compatible software. This signal is externally OR'ed with the A20GATE signal from the keyboard controller and CPURST to control the nA20M input of the CPU. Writing a 0 to bit 1 of the Port 92 Register forces ALT\_A20 low. ALT\_A20 low drives nA20M to the CPU low, if A20GATE from the keyboard controller is also low. Writing a 1 to bit 1 of the Port 92 Register forces ALT\_A20 high. ALT\_A20 high drives nA20M to the CPU high, regardless of the state of A20GATE from the keyboard controller. Upon reset, this signal is driven low.

**Latches On Keyboard and Mouse IRQs**

The implementation of the latches on the keyboard and mouse interrupts are shown in [Figure 8-3](#) and [Figure 8-4](#).

**FIGURE 8-3: KEYBOARD LATCH**

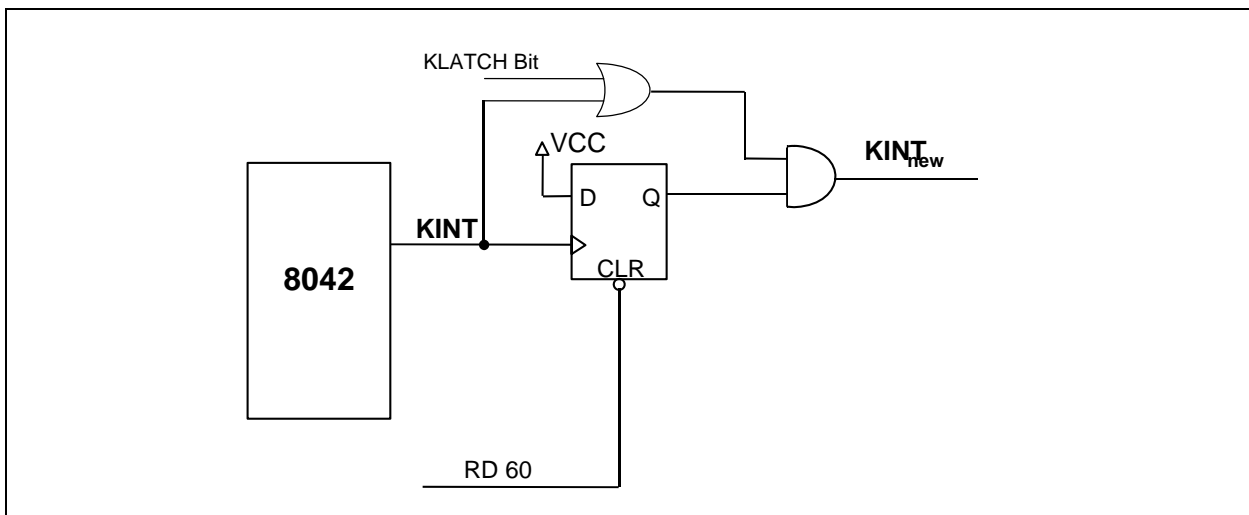
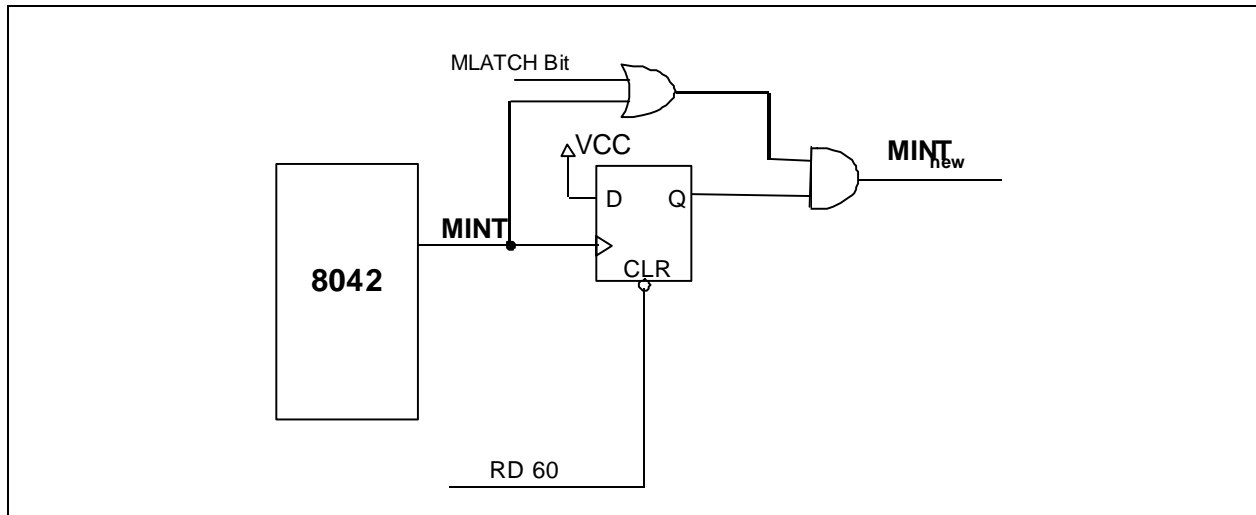


FIGURE 8-4: MOUSE LATCH



The KLATCH and MLATCH bits are located in the KRST\_GA20 register, in Logical Device 1 at F0h.

These bits are defined as follows:

Bit[4]: MLATCH – Mouse Interrupt latch control bit. 0=MINT is the 8042 MINT ANDed with Latched MINT (default), 1=MINT is the latched 8042 MINT.

Bit[3]: KLATCH – Keyboard Interrupt latch control bit. 0=KINT is the 8042 KINT ANDed with Latched KINT (default), 1=KINT is the latched 8042 KINT.

See [Section 8.7, "Detailed Description of Configuration Registers," on page 61](#) for a description of this register.

### 8.5.8 KEYBOARD AND MOUSE PME GENERATION

The SCH5627P sets the associated PME Status bits when the following conditions occur:

- Active (falling) Edge on Keyboard Data Signal (KDAT)
- Active (falling) Edge on Mouse Data Signal (MDAT)

These events can cause a PME to be generated if the associated PME Wake Enable register bit and the global PME\_EN bit are set. Refer [Section 16.0, "Runtime Registers," on page 149](#) for details on the PME Status and Enable registers.

Both the keyboard interrupt and mouse interrupt PMEs can be generated when the part is powered by VCC. The keyboard data and mouse data PMEs can be generated both when the part is powered by VCC, and VTR (VCC=0).

When using the keyboard and mouse data signals for wakeup, it may be necessary to isolate the keyboard signals (KCLK, KDAT, MCLK, MDAT) from the 8042 prior to entering certain system sleep states. This is due to the fact that the normal operation of the 8042 can prevent the system from entering a sleep state or trigger false PME events. The SCH5627P has "isolation" bits for the keyboard and mouse signals, which allow the keyboard and mouse data signals to go into the wakeup logic but block the clock and data signals from the 8042. These bits may be used anytime it is necessary to isolate the 8042 keyboard and mouse signals from the 8042 before entering a system sleep state.

See the Microchip Application Note titled *"Keyboard and Mouse Wakeup Functionality"* for more information.

The bits used to isolate the keyboard and mouse signals from the 8042 are located in Logical Device 1, Register F0h (KRST\_GA20) and are defined below. These bits reset on VTR POR only.

Bit[6]M\_ISO. Enables/disables isolation of mouse signals into 8042. Does not affect the MDAT signal to The mouse wakeup (PME) logic.

1 = block mouse clock and data signals into 8042

0 = do not block mouse clock and data signals into 8042

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Bit[5] K\_ISO. Enables/disables isolation of keyboard signals into 8042. Does not affect the KDAT signal to the keyboard wakeup (PME) logic.

1 = block keyboard clock and data signals into 8042

0 = do not block keyboard clock and data signals into 8042

When the keyboard and/or mouse isolation bits are used, it may be necessary to reset the 8042 upon exiting the sleep state. If either of the isolation bits are set prior to entering a sleep state where VCC goes inactive (S3-S5), then the 8042 must be reset upon exiting the sleep mode. Write 40h to global configuration register 2Ch to reset the 8042. The 8042 must then be taken out of reset by writing 00h to register 2Ch since the bit that resets the 8042 is not self-clearing. Caution: Bit 6 of configuration register 2Ch is used to put the 8042 into reset - do not set any of the other bits in register 2Ch, as this may produce undesired results.

It is not necessary to reset the 8042 if the isolation bits are used for a sleep state where VCC does not go inactive (S1, S2).

When the external keyboard and external mouse are powered up, the KDAT and MDAT lines are driven low. This sets the KBD bit (D3) and the MOUSE bit (D4) of the PME Wake Status Register since the KDAT and MDAT signals cannot be isolated internal to the part. This causes an IO\_PME# to be generated if the keyboard and/or mouse PME events are enabled. Note that the keyboard and mouse isolation bits only prevent the internal 8042 in the part from setting these status bits.

## Case 1: Keyboard and/or Mouse Powered by VTR

The KBD and/or MOUSE status bits will be set upon a VTR POR if the keyboard and/or mouse are powered by VTR. In this case, an IO\_PME# will not be generated, since the keyboard and mouse PME enable bits are reset to zero on a VTR POR. The BIOS software needs to clear these PME status bits after power-up.

## Case 2: Keyboard and/or Mouse Powered by VCC

The KBD and/or MOUSE status bits will be set upon a VCC POR if the keyboard and/or mouse are powered by VCC. In this case, an IO\_PME# will be generated if the enable bits were set for wakeup, since the keyboard and mouse PME enable bits are VTR powered. If the keyboard and mouse are powered by VCC, the enable bits for keyboard and mouse events should be cleared prior to entering a sleep state where VCC is removed (i.e., S3) to prevent a false PME from being generated. In this case, the keyboard and mouse should only be used as PME and/or wake events from the S0 and/or S1 states. The BIOS software needs to clear these PME status bits after power-up.

## 8.6 'Wake on Specific Key' Option

bit The SCH5627P has logic to detect a single keyboard scan code for wakeup (PME generation). The scan code is programmed onto the Keyboard Scan Code Register, a runtime register at offset 26h from the base address located in the primary base I/O address in Logical Device A. This register is powered by VTR and reset on VTR POR.

bit The PME status bit for this event is located in the PME\_STS1 register at bit 5 and the PME enable bit for this event is located in the PME\_EN1 register at bit 5. See [Section 16.3.3, "PME\\_STS1 Register," on page 152](#) and [Section 16.3.6, "PME\\_EN1 Register," on page 155](#) for a definition of these registers.

bit Data transmissions from the keyboard consist of an 11-bit serial data stream. A logic 1 is sent at an active high level. The following table shows the functions of the bits.

**TABLE 8-6: BIT FUNCTION**

Bit	Function
1	Start bit (always 0)
2	Data bit 0 (least significant bit)
3	Data bit 1
4	Data bit 2
5	Data bit 3
6	Data bit 4
7	Data bit 5
8	Data bit 6
9	Data bit 7 (most significant bit)
10	Parity bit (odd parity)
11	Stop Bit (always 1)

The process to find a match for the scan code stored in the Keyboard Scan Code register is as follows:

Begin sampling the data at the first falling edge of the keyboard clock following a period where the clock line has been high for 115-145usec. The data at this first clock edge is the start bit. The first data bit follows the start bit (clock 2). Sample the data on each falling edge of the clock. Store the eight bits following the stop bit to compare with the scan code stored in the Keyboard Scan Code register. Sample the comparator within 100usec of the falling edge of clock 9 (for example, at clock 10).

Sample the parity bit and check that the 8 data bits plus the parity bit always have an odd number of 1's (odd parity).

Repeat until a match is found. If the 8 data bits match the scan code stored in the Keyboard Scan Code register and the parity is correct, then it is considered a match. When a match is found and if the stop bit is 1, set the event status bit (bit 5 of the PME\_STS1 register) to '1' within 100usec of the falling edge of clock 10.

The state machine will reset after 11 clocks and the process will restart. The process will continue until it is shut off by setting the SPEKEY\_EN bit (see description below).

The state machine will reset if there is a period where the clock remains high for more than one keyboard clock period (115-145usec) in the middle of the transmission (i.e., before clock 11). This is to prevent the generation of a false PME.

The SPEKEY\_EN bit at bit 1 of the SPEKEY Configuration register at F0h in Logical Device A is used to control the "wake-on-specific feature. This bit is used to turn the logic for this feature on and off. The logic will draw no power when disabled. The bit is defined as follows:

0 = "Wake on specific key" logic is on (default)

1 = "Wake on specific key" logic is off

**Note:** The generation of a PME for this event is controlled by the PME enable bit (located in the PME\_EN1 register at bit 5) when the logic for feature is turned on.

## 8.7 Detailed Description of Configuration Registers

### 8.7.1 ACTIVATE

**TABLE 8-7: ACTIVATE REGISTER**

<b>HOST OFFSET</b>	30h						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	330h						32-bit	<b>EC SIZE</b>	
<b>POWER</b>	VTR						00b	nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R	R	R	R	R	R	R	R/W	
<b>EC TYPE</b>	R	R	R	R	R	R	R	R/W	
<b>BIT NAME</b>	Reserved							Activate	

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## Activate

When this bit is 1, the 8042 logical device is powered and functional. When this bit is 0, the 8042 logical device is powered down and inactive.

### 8.7.2 KRST\_GA20

**TABLE 8-8: KRST\_GA20 REGISTER**

HOST OFFSET	F0h						8-bit	HOST SIZE	
EC OFFSET	3F0h						8-bit	EC SIZE	
POWER	VTR						Bits[6:5] reset on <code>nSYS_RST</code> only	<code>nSYS_RST</code> or <code>nSIO_RESET</code> DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
HOST TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R	R	
EC TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R	R	
BIT NAME	POL	M_ISO	K_ISO	MLATCH	KLATCH	P92	Reserved		

## P92

Port 92 Select.

0= Port 92 Disabled (default)

1= Port 92 Enabled

## KLATCH

0= KINT is the 8042 KINT ANDed with Latched KINT (default)

1= KINT is the latched 8042 KINT

## MLATCH

0= MINT is the 8042 MINT ANDed with Latched MINT (default)

1= MINT is the latched 8042 MINT

## K\_ISO

Enables/disables isolation of keyboard signals into 8042. Does not affect KDAT signal to keyboard wakeup (PME) logic.

0= do not block keyboard clock and data signals into 8042 (default)

1= block keyboard clock and data signals into 8042

## M\_ISO

Enables/disables isolation of mouse signals into 8042. Does not affect MDAT signal to mouse wakeup (PME) logic.

1= block mouse clock and data signals into 8042 (default)

0= do not block mouse clock and data signals into 8042

## POL

Polarity Select for P12

0= P12 active low (default)

1= P12 active highz

## 8.7.3 KEYBOARD SELECT

**TABLE 8-9: KEYBOARD SELECT REGISTER**

<b>HOST OFFSET</b>	F1h						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	3F1h						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VTR			Bits[6:5] reset on <i>nSYS_RST</i> only			<sup>00b</sup>	<i>nSYS_RST</i> or <i>nSIO_RESET</i> <b>DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R	R	R	R	R	R	R	R/W	
<b>EC TYPE</b>	R	R	R	R	R	R	R	R/W	
<b>BIT NAME</b>	Reserved							KMS	

### KMS

Keyboard//Mouse swap. This bit is used to swap the keyboard and mouse clock and data pins into/out of the 8042 as follows:

0= do not swap the keyboard and mouse clock and data pins (default)

1= internally swap the KCLK pin and the MCLK pin, and the KDAT pin and the MDAT pin into/out of the 8042.

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## 9.0 SERIAL PORT (UART)

### 9.1 General Description

The SCH5627P incorporates two full function UARTs. Each UART is compatible with the 16450, the 16450 ACE registers and the 16C550A. The UARTs perform serial-to-parallel conversion on received characters and parallel-to-serial conversion on transmit characters. Two sets of baud rates are provided. When the 1.8432 MHz source clock is selected, standard baud rates from 50 to 115.2K are available. When the source clock is 32.26 MHz, baud rates from 126K to 2,016K are available. The character options are programmable for 1 start; 1, 1.5 or 2 stop bits; even, odd, sticky or no parity; and prioritized interrupts. The UART contains a programmable baud rate generator that is capable of dividing the input clock or crystal by a number from 1 to 65535. The UART is also capable of supporting the MIDI data rate. Refer to the Configuration Registers for information on disabling, powerdown and changing the base address of the UART. The interrupt from a UART is enabled by programming OUT2 of the UART to a logic "1". OUT2 being a logic "0" disables the UART's interrupt. The UART is accessible by both the Host and the EC.

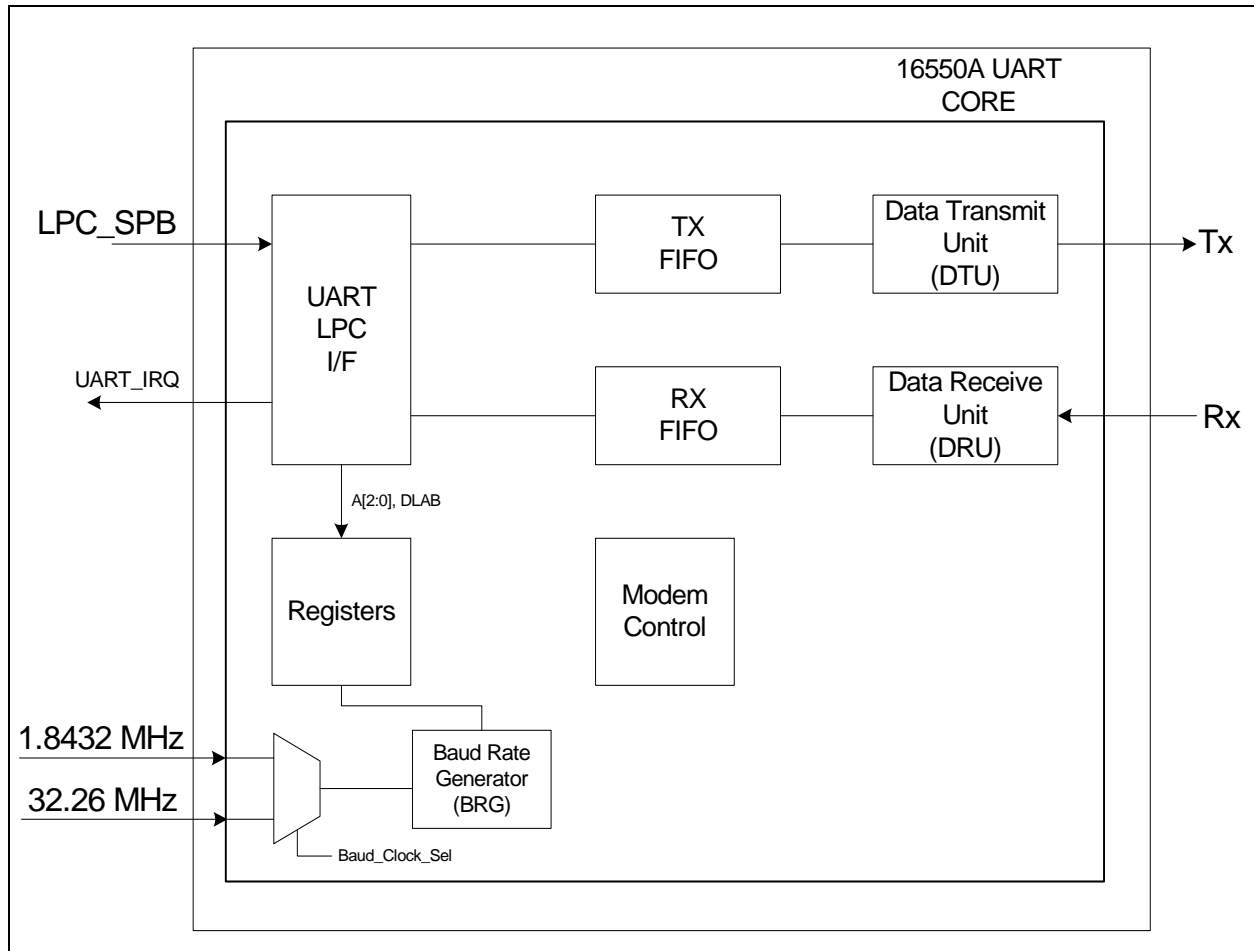
#### 9.1.1 FEATURES

- Programmable word length, stop bits and parity
- Programmable baud rate generator
- Interrupt generator
- Loop-back mode
- Interface registers
- 16-byte Transmit FIFO
- 16-byte Receive FIFO
- Multiple clock sources
- VTR & VCC operation
- Pin Polarity control
- Low power sleep mode



## 9.1.2 BLOCK DIAGRAM

**FIGURE 9-1: SERIAL PORT (UART) BLOCK DIAGRAM**



## 9.1.3 BLOCK DIAGRAM SIGNAL LIST

**TABLE 9-1: SERIAL PORT (UART) REGISTER INTERFACE PORT LIST**

Signal Name	Direction	Description
UART_IRQ	Output	Host Interrupt routed to SERIRQ
LPC_SPB	I/O Bus	Bus used for register access
RX	Input	UART Receive data pin
TX	Output	UART Transmit data pin
1.8432 MHz	Input	UART clock input (1.8462MHz)
32.26 MHz	Input	UART alternate clock input (32.26 MHz)

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## 9.2 Power, Clocks and Reset

### 9.2.1 POWER DOMAIN

This block is powered by the VTR Power Supply.

See [Section 5.9, "Registers," on page 43](#) for details on power domains.

### 9.2.2 CLOCKS

[Registers](#) in this block are clocked at the [Host Bus Clock](#) rate which is derived by the master clock MCLK. Baud rates are derived from 1.8432MHz clock input. The 1.8432MHz. is itself derived from either MCLK or sourced from the 96MHz PLL. An alternate 32.26MHz clock, derived from MCLK, is also available as a clock input.

See [Section 5.5, "Clock Sources," on page 32](#) for details on clocks.

**Note:** When the [CLK\\_SRC](#) bit in the [Configuration Select Register](#) is '1', the baud clock is derived from the 96MHz PLL.

### 9.2.3 RESET

[Table 9-2](#) details the effect of [nSYS\\_RST](#) or [nSIO\\_RESET](#) on each of the runtime registers of the Serial Port.

**TABLE 9-2: RESET FUNCTION TABLE**

Register/Signal	Reset Control	Reset State
Interrupt Enable Register	RESET	All bits low
Interrupt Identification Reg.		Bit 0 is high; Bits 1 - 7 low
FIFO Control		All bits low
Line Control Reg.		
MODEM Control Reg.		
Line Status Reg.		All bits low except 5, 6 high
MODEM Status Reg.		Bits 0 - 3 low; Bits 4 - 7 input
TXD1, TXD2		High
INTRPT (RCVR errs)	RESET/Read LSR	Low
INTRPT (RCVR Data Ready)	RESET/Read RBR	
INTRPT (THRE)	RESET/Read IIR/Write THR	
OUT2B	RESET	High
RTSB		
DTRB		
OUT1B		
RCVR FIFO	RESET/ FCR1*FCR0/_FCR0	All Bits Low
XMIT FIFO	RESET/ FCR1*FCR0/_FCR0	

The Runtime registers can be configured to be reset on either [nSYS\\_RST](#) or [nSIO\\_RESET](#). The [POWER](#) bit in the [Configuration Select Register](#) controls which reset effects the runtime registers. Refer to [Table 9-2](#) for effected registers and [Section 5.0, "Power, Clocks and Resets"](#) for definitions of [nSYS\\_RST](#) on page 37 or [nSIO\\_RESET](#) on page 38.

See [Section 5.9, "Registers," on page 43](#) for details on reset.

## 9.3 Interrupts

### 9.3.1 SERIAL PORT (UART) SIRQ ROUTING

The [Serial Port \(UART\)](#) can generate a SIRQ event to the Host. See the [Interrupt Enable Register \(IER\)](#) on page 70 and the [Interrupt Identification Register \(IIR\)](#) on page 71 for a description of interrupt generation. This interrupt is routed to the SIRQ block (see [SERIRQ Configuration Registers](#) on page 43).

## 9.4 Registers

[Table 9-3](#) is a register summary for one instance of the [Serial Port \(UART\)](#). The LPC I/O address for each Run-Time Register is described below as an offset from its Base Address Register. Each Configuration register access through the [Host Access Port](#) is via its LDN indicated in [Table 4-1, "Host Logical Devices on SCH5627P,"](#) on page 26 and its [Host Access Port](#) index which is described as "Host Config Index" in the tables below.

**TABLE 9-3: SERIAL PORT REGISTER SUMMARY**

Register Name	Offset	DLAB ( <a href="#">Note 9-1</a> )	Size	Type	Notes
<b>RUNTIME REGISTERS</b>					
<a href="#">Receive Buffer Register (RB)</a> ,	00h	0	8	R	
<a href="#">Transmit Buffer Register (TB)</a>	00h	0	8	W	
<a href="#">Programmable Baud Rate Generator</a>	00h	1	8	R/W	
<a href="#">Programmable Baud Rate Generator</a>	01h	1	8	R/W	
<a href="#">Interrupt Enable Register (IER)</a>	01h	0	8	R/W	
<a href="#">FIFO Control Register (FCR)</a> ,	02h	X	8	W	
<a href="#">Interrupt Identification Register (IIR)</a>	02h	X	8	R	
<a href="#">Line Control Register (LCR)</a>	03h	X	8	R/W	
<a href="#">Modem Control Register (MCR)</a>	04h	X	8	R/W	
<a href="#">Line Status Register (LSR)</a>	05h	X	8	R	
<a href="#">Modem Status Register (MSR)</a>	06h	X	8	R	
<a href="#">Scratchpad Register (SCR)</a>	07h	X	8	R/W	
<b>CONFIGURATION REGISTERS</b>					
<a href="#">Activate</a>	30h	-	8	R/W	
<a href="#">Configuration Select Register</a>	F0h	-	8	R/W	

**Note 9-1** DLAB is Bit 7 of the Line Control Register.

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**TABLE 9-4: REGISTER SUMMARY**

Address (Note 9-2)	R/W	Register Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ADDR = 0 DLAB = 0	R	Receive Buffer	Data Bit 7	Data Bit 6	Data Bit 5	Data Bit 4	Data Bit 3	Data Bit 2	Data Bit 1	Data Bit 0 <a href="#">(Note 9-3)</a>
ADDR = 0 DLAB = 0	W	Transmitter Holding	Data Bit 7	Data Bit 6	Data Bit 5	Data Bit 4	Data Bit 3	Data Bit 2	Data Bit 1	Data Bit 0
ADDR = 1 DLAB = 0	R/W	Interrupt Enable	Reserved				Enable Modem Status Interrupt (EMSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETHREI)	Enable Received Data Available Interrupt (ERDAI)
ADDR = 2	R	Interrupt Ident	FIFOs Enabled <a href="#">(Note 9-7)</a>	FIFOs Enabled <a href="#">(Note 9-7)</a>	Reserved		Interrupt ID Bit <a href="#">(Note 9-7)</a>	Interrupt ID Bit	Interrupt ID Bit	"0" if Interrupt Pending
ADDR = 2	W	FIFO Control	RCVR Trigger MSB	RCVR Trigger LSB	Reserved		DMA Mode Select <a href="#">(Note 9-8)</a>	XMIT FIFO Reset	RCVR FIFO Reset	FIFO Enable
ADDR = 3	R/W	Line Control	Divisor Latch Access Bit (DLAB)	Set Break	Stick Parity	Even Parity Select (EPS)	Parity Enable (PEN)	Number of Stop Bits (STB)	Word Length Select Bit 1 (WLS1)	Word Length Select Bit 0 (WLS0)
ADDR = 4	R/W	MODEM Control	Reserved			Loop	OUT2 <a href="#">(Note 9-5)</a>	OUT1 <a href="#">(Note 9-5)</a>	Request to Send (RTS)	Data Terminal Ready (DTR)
ADDR = 5	R/W	Line Status	Error in RCVR FIFO <a href="#">(Note 9-7)</a>	Transmitter Empty (TEMT) <a href="#">(Note 9-4)</a>	Transmitter Holding Register (THRE)	Break Interrupt (BI)	Framing Error (FE)	Parity Error (PE)	Overrun Error (OE)	Data Ready (DR)
ADDR = 6	R/W	MODEM Status	Data Carrier Detect (DCD)	Ring Indicator (RI)	Data Set Ready (DSR)	Clear to Send (CTS)	Delta Data Carrier Detect (DDCD)	Trailing Edge Ring Indicator (TERI)	Delta Data Set Ready (DDSR)	Delta Clear to Send (DCTS)
ADDR = 7	R/W	Scratch r <a href="#">(Note 9-6)</a>	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
ADDR = 0 DLAB = 1	R/W	Divisor Latch (LS)	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
ADDR = 1 DLAB = 1	R/W	Divisor Latch (MS)	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8

**UART Register Summary Notes:**

- Note 9-2** DLAB is Bit 7 of the Line Control Register (ADDR = 3).
- Note 9-3** Bit 0 is the least significant bit. It is the first bit serially transmitted or received.
- Note 9-4** When operating in the XT mode, this bit will be set any time that the transmitter shift register is empty.
- Note 9-5** This bit no longer has a pin associated with it.
- Note 9-6** When operating in the XT mode, this register is not available.
- Note 9-7** These bits are always zero in the non-FIFO mode.
- Note 9-8** Writing a one to this bit has no effect. DMA modes are not supported in this chip.

## 9.5 Detailed Description of Accessible Runtime Registers

### 9.5.1 RECEIVE BUFFER REGISTER (RB)

**TABLE 9-5: RECEIVE BUFFER (RB)**

<b>HOST OFFSET</b>	0h (DLAB=0)						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	0h (DLAB=0)						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						00h	nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R	R	R	R	R	R	R	R	
<b>EC TYPE</b>	R	R	R	R	R	R	R	R	
<b>BIT NAME</b>	Received Data byte [7:0]								

#### Received Data Byte

This register holds the received incoming data byte. Bit 0 is the least significant bit, which is transmitted and received first. Received data is double buffered; this uses an additional shift register to receive the serial data stream and convert it to a parallel 8 bit word which is transferred to the Receive Buffer register. The shift register is not accessible.

### 9.5.2 TRANSMIT BUFFER REGISTER (TB)

**TABLE 9-6: TRANSMIT BUFFER (TB)**

<b>HOST OFFSET</b>	0h (DLAB=0)						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	0h (DLAB=0)						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						00h	nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	W	W	W	W	W	/W	W	W	
<b>EC TYPE</b>	W	W	W	W	W	W	W	W	
<b>BIT NAME</b>	Transmit data byte [7:0]								

#### Transmit Data Byte

This register contains the data byte to be transmitted. The transmit buffer is double buffered, utilizing an additional shift register (not accessible) to convert the 8 bit data word to a serial format. This shift register is loaded from the Transmit Buffer when the transmission of the previous byte is complete.

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## 9.5.3 INTERRUPT ENABLE REGISTER (IER)

**TABLE 9-7: INTERRUPT ENABLE (IER)**

<b>HOST OFFSET</b>	1h (DLAB=0)					8-bit		<b>HOST SIZE</b>	
<b>EC OFFSET</b>	1h (DLAB=0)					8-bit		<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR					00h		nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R	R	R	R	R/W	R/W	R/W	R/W	
<b>EC TYPE</b>	R	R	R	R	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Reserved				EMSI	ELSI	ETHREI	ERDAI	

The lower four bits of this register control the enables of the five interrupt sources of the Serial Port interrupt. It is possible to totally disable the interrupt system by resetting bits 0 through 3 of this register. Similarly, setting the appropriate bits of this register to a high, selected interrupts can be enabled. Disabling the interrupt system inhibits the Interrupt Identification Register and disables any Serial Port interrupt out of the SCH5627P. All other system functions operate in their normal manner, including the Line Status and MODEM Status Registers. The contents of the Interrupt Enable Register are described below.

### ERDAI

This bit enables the Received Data Available Interrupt (and timeout interrupts in the FIFO mode) when set to logic “1”.

### ETHREI

This bit enables the Transmitter Holding Register Empty Interrupt when set to logic “1”.

### ELSI

This bit enables the Received Line Status Interrupt when set to logic “1”. The error sources causing the interrupt are Overrun, Parity, Framing and Break. The Line Status Register must be read to determine the source.

### EMSI

This bit enables the MODEM Status Interrupt when set to logic “1”. This is caused when one of the Modem Status Register bits changes state.

## 9.5.4 FIFO CONTROL REGISTER (FCR)

**TABLE 9-8: FIFO CONTROL (FCR)**

<b>HOST OFFSET</b>	02h					8-bit		<b>HOST SIZE</b>	
<b>EC OFFSET</b>	02h					8-bit		<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR					00h		nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	W	W	W	W	W	W	W	W	
<b>EC TYPE</b>	W	W	W	W	W	W	W	W	
<b>BIT NAME</b>	RCV FIFO Trigger Level		Reserved			Clear XMIT FIFO	Clear RCV FIFO	EXRF	

This is a write only register at the same location as the IIR.

**Note:** DMA is not supported.

## EXRF

Enable XMIT and RECV FIFO. Setting this bit to a logic “1” enables both the XMIT and RCVR FIFOs. Clearing this bit to a logic “0” disables both the XMIT and RCVR FIFOs and clears all bytes from both FIFOs. When changing from FIFO Mode to non-FIFO (16450) mode, data is automatically cleared from the FIFOs. This bit must be a 1 when other bits in this register are written to or they will not be properly programmed.

### Clear RECV FIFO

Setting this bit to a logic “1” clears all bytes in the RCVR FIFO and resets its counter logic to “0”. The shift register is not cleared. This bit is self-clearing.

### Clear XMIT FIFO

Setting this bit to a logic “1” clears all bytes in the XMIT FIFO and resets its counter logic to “0”. The shift register is not cleared. This bit is self-clearing.

### RECV FIFO Trigger Level

These bits are used to set the trigger level for the RCVR FIFO interrupt.

**TABLE 9-9: RECV FIFO TRIGGER LEVEL**

Bit 7	Bit 6	RECV FIFO Trigger Level (Bytes)
0	0	1
	1	4
1	0	8
	1	14

## 9.5.5 INTERRUPT IDENTIFICATION REGISTER (IIR)

**TABLE 9-10: INTERRUPT IDENTIFICATION (IIR)**

HOST OFFSET	02h						8-bit	HOST SIZE	
EC OFFSET	02h						8-bit	EC SIZE	
POWER	VCC or VTR						01h	nSYS_RST or nSIO_RESET DEFAULT	
BYTE3 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
HOST TYPE	R	R	R	R	R	R	R	R	
EC TYPE	R	R	R	R	R	R	R	R	
BIT NAME	FIFO_En		Reserved			IntID		IPEND	

By accessing this register, the host CPU can determine the highest priority interrupt and its source. Four levels of priority interrupt exist. They are in descending order of priority:

1. Receiver Line Status (highest priority)
2. Received Data Ready
3. Transmitter Holding Register Empty
4. MODEM Status (lowest priority)

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Information indicating that a prioritized interrupt is pending and the source of that interrupt is stored in the Interrupt Identification Register (refer to [Table 9-11](#)). When the CPU accesses the IIR, the Serial Port freezes all interrupts and indicates the highest priority pending interrupt to the CPU. During this CPU access, even if the Serial Port records new interrupts, the current indication does not change until access is completed. The contents of the IIR are described below.

## IPEND

This bit can be used in either a hardwired prioritized or polled environment to indicate whether an interrupt is pending. When bit 0 is a logic “0”, an interrupt is pending and the contents of the IIR may be used as a pointer to the appropriate internal service routine. When bit 0 is a logic “1”, no interrupt is pending.

## IntID

These three bits of the IIR are used to identify the highest priority interrupt pending as indicated by [Table 9-11](#). In non-FIFO mode, Bit[3] is a logic “0”. In FIFO mode Bit[3] is set along with Bit[2] when a timeout interrupt is pending.

**TABLE 9-11: INTERRUPT CONTROL TABLE**

FIFO Mode Only	Interrupt Identification Register			Interrupt Set and Reset Functions				
	Bit 3	Bit 2	Bit 1	Bit 0	Priority Level	Interrupt Type	Interrupt Source	Interrupt Reset Control
0	0	0	1		-	None	None	-
		1	1	0	Highest	Receiver Line Status	Overrun Error, Parity Error, Framing Error or Break Interrupt	Reading the Line Status Register
1			0		Second	Received Data Available	Receiver Data Available	Read Receiver Buffer or the FIFO drops below the trigger level.
						Character Timeout Indication	No Characters Have Been Removed From or Input to the RCVR FIFO during the last 4 Char times and there is at least 1 char in it during this time	Reading the Receiver Buffer Register
0	0	1			Third	Transmitter Holding Register Empty	Transmitter Holding Register Empty	Reading the IIR Register (if Source of Interrupt) or Writing the Transmitter Holding Register
		0	0		Fourth	MODEM Status	Clear to Send or Data Set Ready or Ring Indicator or Data Carrier Detect	Reading the MODEM Status Register

## FIFO\_En

These two bits are set when the FIFO CONTROL Register bit 0 equals 1.



## 9.5.6 LINE CONTROL REGISTER (LCR)

**TABLE 9-12: LINE CONTROL (LCR)**

<b>HOST OFFSET</b>	03h						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	03h						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						00h	nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>EC TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	DLAB	Break Control	Stick Parity	Parity Select	Enable Parity	Stop Bits	Word Length		

This register contains the format information of the serial line. The bit definitions are:

### Word Length

These two bits specify the number of bits in each transmitted or received serial character. The encoding of bits 0 and 1 is as follows:

### Stop Bits

This bit specifies the number of stop bits in each transmitted or received serial character. [Table 9-13](#) summarizes the information.

**TABLE 9-13: STOP BITS**

Bit 2	Word Length	Number of Stop Bits
0	--	1
1	5 bits	1.5
	6 bits	
	7 bits	
	8 bits	

**Note 9-9** The receiver will ignore all stop bits beyond the first, regardless of the number used in transmitting.

**TABLE 9-14: SERIAL CHARACTER**

Bit 1	Bit 0	Word Length
0	0	5 Bits
0	1	6 Bits
1	0	7 Bits
1	1	8 Bits

The Start, Stop and Parity bits are not included in the word length.

### Enable Parity

Parity Enable bit. When bit 3 is a logic "1", a parity bit is generated (transmit data) or checked (receive data) between the last data word bit and the first stop bit of the serial data. (The parity bit is used to generate an even or odd number of 1s when the data word bits and the parity bit are summed).

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## Parity Select

Even Parity Select bit. When bit 3 is a logic “1” and bit 4 is a logic “0”, an odd number of logic “1”s is transmitted or checked in the data word bits and the parity bit. When bit 3 is a logic “1” and bit 4 is a logic “1” an even number of bits is transmitted and checked.

## Stick Parity

Stick Parity bit. When parity is enabled it is used in conjunction with bit 4 to select Mark or Space Parity. When LCR bits 3, 4 and 5 are 1 the Parity bit is transmitted and checked as a 0 (Space Parity). If bits 3 and 5 are 1 and bit 4 is a 0, then the Parity bit is transmitted and checked as 1 (Mark Parity). If bit 5 is 0 Stick Parity is disabled.

Bit 3 is a logic “1” and bit 5 is a logic “1”, the parity bit is transmitted and then detected by the receiver in the opposite state indicated by bit 4.

## Break Control

Set Break Control bit. When bit 6 is a logic “1”, the transmit data output (TXD) is forced to the Spacing or logic “0” state and remains there (until reset by a low level bit 6) regardless of other transmitter activity. This feature enables the Serial Port to alert a terminal in a communications system.

## DLAB

Divisor Latch Access Bit (DLAB). It must be set high (logic “1”) to access the Divisor Latches of the Baud Rate Generator during read or write operations. It must be set low (logic “0”) to access the Receiver Buffer Register, the Transmitter Holding Register, or the Interrupt Enable Register.

### 9.5.7 MODEM CONTROL REGISTER (MCR)

**TABLE 9-15: MODEM CONTROL (MCR)**

<b>HOST OFFSET</b>	04h			8-bit			<b>HOST SIZE</b>	
<b>EC OFFSET</b>	04h			8-bit			<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR			00h			<b>nSYS_RST or nSIO_RESET DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>HOST TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>EC TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Reserved			LOOP-BACK	OUT2	OUT1	RTS	DTR

This 8-bit register controls the interface with the MODEM or data set (or device emulating a MODEM). The contents of the MODEM control register are described below.

## DTR

This bit controls the Data Terminal Ready (nDTR) output. When bit 0 is set to a logic “1”, the nDTR output is forced to a logic “0”. When bit 0 is a logic “0”, the nDTR output is forced to a logic “1”.

## RTS

This bit controls the Request To Send (nRTS) output. Bit 1 affects the nRTS output in a manner identical to that described above for bit 0.

## OUT1

This bit controls the Output 1 (OUT1) bit. This bit does not have an output pin and can only be read or written by the CPU.

## OUT2

Output 2 (OUT2). This bit is used to enable an UART interrupt. When OUT2 is a logic “0”, the serial port interrupt output is forced to a high impedance state - disabled. When OUT2 is a logic “1”, the serial port interrupt outputs are enabled.

## LOOPBACK

This bit provides the loopback feature for diagnostic testing of the Serial Port. When bit 4 is set to logic “1”, the following occur:

1. The TXD is set to the Marking State (logic “1”).
2. The receiver Serial Input (RXD) is disconnected.
3. The output of the Transmitter Shift Register is “looped back” into the Receiver Shift Register input.
4. All MODEM Control inputs (nCTS, nDSR, nRI and nDCD) are disconnected.
5. The four MODEM Control outputs (nDTR, nRTS, OUT1 and OUT2) are internally connected to the four MODEM Control inputs (nDSR, nCTS, RI, DCD).
6. The Modem Control output pins are forced inactive high.
7. Data that is transmitted is immediately received.

This feature allows the processor to verify the transmit and receive data paths of the Serial Port. In the diagnostic mode, the receiver and the transmitter interrupts are fully operational. The MODEM Control Interrupts are also operational but the interrupts' sources are now the lower four bits of the MODEM Control Register instead of the MODEM Control inputs. The interrupts are still controlled by the Interrupt Enable Register.

### 9.5.8 LINE STATUS REGISTER (LSR)

**TABLE 9-16: LINE STATUS (LSR)**

<b>HOST OFFSET</b>	05h						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	05h						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						60h	nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R	R	R	R	R	R	R	R	
<b>EC TYPE</b>	R	R	R	R	R	R	R	R	
<b>BIT NAME</b>	FIFO Error	Trans- mit Error	Trans- mit Empty	Break Interrupt	Frame Error	Parity Error	Overrun Error	Data Ready	

### Data Ready

Data Ready (DR). It is set to a logic “1” whenever a complete incoming character has been received and transferred into the Receiver Buffer Register or the FIFO. Bit 0 is reset to a logic “0” by reading all of the data in the Receive Buffer Register or the FIFO.

### Overrun Error

Overrun Error (OE). Bit 1 indicates that data in the Receiver Buffer Register was not read before the next character was transferred into the register, thereby destroying the previous character. In FIFO mode, an overrun error will occur only when the FIFO is full and the next character has been completely received in the shift register, the character in the shift register is overwritten but not transferred to the FIFO. The OE indicator is set to a logic “1” immediately upon detection of an overrun condition, and reset whenever the Line Status Register is read.

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## Parity Error

Parity Error (PE). Bit 2 indicates that the received data character does not have the correct even or odd parity, as selected by the even parity select bit. The PE is set to a logic "1" upon detection of a parity error and is reset to a logic "0" whenever the Line Status Register is read. In the FIFO mode this error is associated with the particular character in the FIFO it applies to. This error is indicated when the associated character is at the top of the FIFO.

## Frame Error

Framing Error (FE). Bit 3 indicates that the received character did not have a valid stop bit. Bit 3 is set to a logic "1" whenever the stop bit following the last data bit or parity bit is detected as a zero bit (Spacing level). The FE is reset to a logic "0" whenever the Line Status Register is read. In the FIFO mode this error is associated with the particular character in the FIFO it applies to. This error is indicated when the associated character is at the top of the FIFO. The Serial Port will try to resynchronize after a framing error. To do this, it assumes that the framing error was due to the next start bit, so it samples this 'start' bit twice and then takes in the 'data'.

## Break Interrupt

Break Interrupt (BI). Bit 4 is set to a logic "1" whenever the received data input is held in the Spacing state (logic "0") for longer than a full word transmission time (that is, the total time of the start bit + data bits + parity bits + stop bits). The BI is reset after the CPU reads the contents of the Line Status Register. In the FIFO mode this error is associated with the particular character in the FIFO it applies to. This error is indicated when the associated character is at the top of the FIFO. When break occurs only one zero character is loaded into the FIFO. Restarting after a break is received, requires the serial data (RXD) to be logic "1" for at least 1/2 bit time.

Bits 1 through 4 are the error conditions that produce a Receiver Line Status Interrupt BIT 3

**Note 9-10** whenever any of the corresponding conditions are detected and the interrupt is enabled

## Transmit Empty

Transmitter Holding Register Empty (THRE). Bit 5 indicates that the Serial Port is ready to accept a new character for transmission. In addition, this bit causes the Serial Port to issue an interrupt when the Transmitter Holding Register interrupt enable is set high. The THRE bit is set to a logic "1" when a character is transferred from the Transmitter Holding Register into the Transmitter Shift Register. The bit is reset to logic "0" whenever the CPU loads the Transmitter Holding Register. In the FIFO mode this bit is set when the XMIT FIFO is empty, it is cleared when at least 1 byte is written to the XMIT FIFO. Bit 5 is a read only bit.

## Transmit Error

Transmitter Empty (TEMT). Bit 6 is set to a logic "1" whenever the Transmitter Holding Register (THR) and Transmitter Shift Register (TSR) are both empty. It is reset to logic "0" whenever either the THR or TSR contains a data character. Bit 6 is a read only bit. In the FIFO mode this bit is set whenever the THR and TSR are both empty,

## FIFO Error

This bit is permanently set to logic "0" in the 450 mode. In the FIFO mode, this bit is set to a logic "1" when there is at least one parity error, framing error or break indication in the FIFO. This bit is cleared when the LSR is read if there are no subsequent errors in the FIFO.

## 9.5.9 MODEM STATUS REGISTER (MSR)

**TABLE 9-17: MODEM STATUS (MSR)**

<b>HOST ADDRESS</b>	06h						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	06h						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						xxxx0000b	nSYS_RST or nSIO_RESET <b>DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R	R	R	R	R	R	R	R	
<b>EC TYPE</b>	R	R	R	R	R	R	R	R	
<b>BIT NAME</b>	DCD#	RI#	DSR	CTS	DCD	RI	DSR	CTS	

This 8 bit register provides the current state of the control lines from the MODEM (or peripheral device). In addition to this current state information, four bits of the MODEM Status Register (MSR) provide change information.

These bits are set to logic “1” whenever a control input from the MODEM changes state. They are reset to logic “0” whenever the MODEM Status Register is read.

### CTS

Delta Clear To Send (DCTS). Bit 0 indicates that the nCTS input to the chip has changed state since the last time the MSR was read.

### DSR

Delta Data Set Ready (DDSR). Bit 1 indicates that the nDSR input has changed state since the last time the MSR was read.

### RI

Trailing Edge of Ring Indicator (TERI). Bit 2 indicates that the nRI input has changed from logic “0” to logic “1”.

### DCD

Delta Data Carrier Detect (DDCD). Bit 3 indicates that the nDCD input to the chip has changed state.

**Note 9-11** Whenever bit 0, 1, 2, or 3 is set to a logic “1”, a MODEM Status Interrupt is generated.

### CTS

This bit is the complement of the Clear To Send (nCTS) input. If bit 4 of the MCR is set to logic “1”, this bit is equivalent to nRTS in the MCR.

### DSR

This bit is the complement of the Data Set Ready (nDSR) input. If bit 4 of the MCR is set to logic “1”, this bit is equivalent to DTR in the MCR.

### RI#

This bit is the complement of the Ring Indicator (nRI) input. If bit 4 of the MCR is set to logic “1”, this bit is equivalent to OUT1 in the MCR.

### DCD

This bit is the complement of the Data Carrier Detect (nDCD) input. If bit 4 of the MCR is set to logic “1”, this bit is equivalent to OUT2 in the MCR.

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**APPLICATION NOTE:** The Modem Status Register (MSR) only provides the current state of the UART MODEM control lines in Loopback Mode. The SCH5627P does not support external connections for the MODEM Control inputs (nCTS, nDSR, nRI and nDCD) or for the four MODEM Control outputs (nDTR, nRTS, OUT1 and OUT2).

## 9.5.10 SCRATCHPAD REGISTER (SCR)

**TABLE 9-18: SCRATCH PAD (SCR)**

<b>HOST OFFSET</b>	07h						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	07h						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						00h	nSYS_RST or nSIO_RESET DEFAULT	
<b>BYTE3 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>EC TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Scratch								

### Scratch

This 8 bit read/write register has no effect on the operation of the Serial Port. It is intended as a scratchpad register to be used by the programmer to hold data temporarily.

## 9.5.11 PROGRAMMABLE BAUD RATE GENERATOR

**TABLE 9-19: PROGRAMMABLE BAUD RATE GENERATOR**

<b>HOST OFFSET</b>	BYTE1: 01h (DLAB = 1) BYTE0: 00h (DLAB = 1)						8-bit	<b>HOST SIZE</b>	
<b>EC OFFSET</b>	BYTE1: 01h (DLAB = 1) BYTE0: 00h (DLAB = 1)						8-bit	<b>EC SIZE</b>	
<b>POWER</b>	VCC or VTR						0000h	nSYS_RST or nSIO_RESET DEFAULT	
<b>BYTE1 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>EC TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Baud_Clock_Sel	Baud_Rate_Divisor[15:8]							
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>HOST TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>EC TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Baud_Rate_Divisor[7:0]								

## Baud\_Rate\_Divisor

The Serial Port contains a programmable Baud Rate Generator that is capable of dividing the internal clock source by any divisor from 1 to 65535. The clock source is either a 1.8432MHz clock derived from the 64.52MHz ring oscillator or a 32.26Mhz clock also derived from the ring oscillator. The output frequency of the Baud Rate Generator is 16x the Baud rate. Two eight bit latches store the divisor in 16 bit binary format. These Divisor Latches must be loaded during initialization in order to insure desired operation of the Baud Rate Generator. Upon loading either of the Divisor Latches, a 16 bit Baud counter is immediately loaded. This prevents long counts on initial load. If a 0 is loaded into the BRG registers, the output divides the clock by the number 3. If a 1 is loaded, the output is the inverse of the input oscillator. If a two is loaded, the output is a divide by 2 signal with a 50% duty cycle. If a 3 or greater is loaded, the output is low for 2 bits and high for the remainder of the count.

Table 9-20 and Table 9-21 shows the baud rates possible.

**TABLE 9-20: UART BAUD RATES (1.8432MHZ SOURCE)**

Desired Baud Rate	Divisor Used to Generate 16X Clock
50	2304
75	1536
110	1047
134.5	857
150	768
300	384
600	192
1200	96
1800	64
2000	58
2400	48
3600	32
4800	24
7200	16
9600	12
19200	6
38400	3
57600	2
115200	1

**TABLE 9-21: UART BAUD RATES (32.26MHZ SOURCE)**

Desired Baud Rate	BAUD_CLOCK_SEL	Divisor Used to Generate 16X Clock
126000	1	16
168000	1	12
183000	1	11
201600	1	10
224000	1	9
252000	1	8
288000	1	7
336000	1	6
403800	1	5
504100	1	4
672100	1	3

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**TABLE 9-21: UART BAUD RATES (32.26MHZ SOURCE) (CONTINUED)**

Desired Baud Rate	BAUD_CLOCK_SEL	Divisor Used to Generate 16X Clock
1008000	1	2
2016000	1	1

## Baud\_Clock\_Sel

If the CLK\_SRC bit is '0' and the [Baud\\_Clock\\_Sel](#) bit is '0,' the 1.8432MHz clock is used to generate the baud clock. [Table 9-20](#) shows some baud rates that can be generated with this clock. The CLK\_SRC bit is D0 in the UART Logical Device configuration register offset 0xF0.

If the CLK\_SRC bit is '0' and the [Baud\\_Clock\\_Sel](#) bit is '1,' the 32.26MHz clock is used to generate the baud clock. [Table 9-21](#) shows some baud rates that can be generated with this clock.

If the CLK\_SRC bit is '1,' the [Baud\\_Clock\\_Sel](#) bit as no effect.

## 9.6 Detailed Description of Configuration Registers

### 9.6.1 ACTIVATE

**TABLE 9-22: ACTIVATE REGISTER**

HOST OFFSET	30h						8-bit	HOST SIZE	
EC OFFSET	330h						32-bit	EC SIZE	
POWER	VTR						00b	nSYS_RST or nSIO_RESET DEFAULT (SEE <a href="#">Note 9-12</a> )	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
HOST TYPE	R	R	R	R	R	R	R	R/W	
EC TYPE	R	R	R	R	R	R	R	R/W	
BIT NAME	Reserved							Activate	

### Activate

When this bit is 1, the UART logical device is powered and functional. When this bit is 0, the UART logical device is powered down and inactive.

**Note 9-12** If the Power bit in the Configuration Select register is 1, then the Activate register is reset on [nSIO\\_RESET](#). If the Power bit is 0, then the Activate register is reset on [nSYS\\_RST](#).

### 9.6.2 CONFIGURATION SELECT

**TABLE 9-23: CONFIGURATION SELECT REGISTER**

HOST OFFSET	F0h						8-bit	HOST SIZE	
EC OFFSET	3F0h						8-bit	EC SIZE	
POWER	VTR						00b	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
HOST TYPE	R	R	R	R	R	R	R	R/W	
EC TYPE	R	R	R	R	R	R/W	R/W	R/W	
BIT NAME	Reserved					Polarity	Power	CLK_SRC	



## CLK\_SRC

When this bit is 0, the UART clock is derived from the internal ring oscillator. When this bit is 1, the UART clock is derived from an external clock source

## POWER

When this bit is 1, the UART Runtime Registers (the registers at offsets 0h through 7h from the base of the UART Logical Device) are controlled by VCC. They are set to their POR defaults on a [nSIO\\_RESET](#).

When this bit is 0, the UART Runtime Registers are controlled by VTR. They are set to their POR defaults on an [nSYS\\_RST](#).

## POLARITY

When the Polarity bit is asserted ('1'), the UART\_TX and UART\_RX pins functions are inverted. When the Polarity bit is not asserted (default), the UART\_TX and UART\_RX pins functions are not inverted.

## 9.7 Sleep Enable/Clock Request Power state controls

**TABLE 9-24: GENERIC BLOCK CLOCKING MODEL BEHAVIOR**

External Sleep Input	Block Idle Status	Clock Required Status Output	State	Description
X	X	0	DISABLED	Block is disabled by firmware and the core clock is not needed. Note: it is up to the host to maintain that the block is not in use before the internal ENABLE bit is asserted.
0	NOT IDLE	1	NORMAL OPERATION	The block is neither disabled by firmware nor commanded to sleep.
	IDLE	0		
1	NOT IDLE	1	PREPARING TO SLEEP	A sleep command has been asserted but the core clock is still required because the block is not idle.
	IDLE	0	SLEEPING	A sleep command has been asserted, the block is idle and the core clock can be stopped.

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## 10.0 PARALLEL PORT

The SCH5627P incorporates an IBM XT/AT compatible parallel port. This supports the optional PS/2 type bi-directional parallel port (SPP), the Enhanced Parallel Port (EPP) and the Extended Capabilities Port (ECP) parallel port modes. Refer to the Configuration Registers for information on disabling, power-down, changing the base address of the parallel port, and selecting the mode of operation.

The parallel port also incorporates Microchip's ChiProtect circuitry, which prevents possible damage to the parallel port due to printer power-up.

The functionality of the Parallel Port is achieved through the use of eight addressable ports, with their associated registers and control gating. The control and data port are read/write by the CPU, the status port is read/write in the EPP mode. The address map of the Parallel Port is shown below:

DATA PORT	BASE ADDRESS + 00H
STATUS PORT	BASE ADDRESS + 01H
CONTROL PORT	BASE ADDRESS + 02H
EPP ADDR PORT	BASE ADDRESS + 03H
EPP DATA PORT 0	BASE ADDRESS + 04H
EPP DATA PORT 1	BASE ADDRESS + 05H
EPP DATA PORT 2	BASE ADDRESS + 06H
EPP DATA PORT 3	BASE ADDRESS + 07H

**TABLE 10-1: REGISTER BIT MAP**

	D0	D1	D2	D3	D4	D5	D6	D7	Note
DATA PORT	PD0	PD1	PD2	PD3	PD4	PD5	PD6	PD7	10-1
STATUS PORT	TMOUT	0	0	nERR	SLCT	PE	ACK#	nBUSY	10-1
CONTROL PORT	STROBE	AUTOFD	INIT#	SLC	IRQE	PCD	0	0	10-1
EPP ADDR PORT	PD0	PD1	PD2	PD3	PD4	PD5	PD6	PD7	10-2
EPP DATA PORT 0	PD0	PD1	PD2	PD3	PD4	PD5	PD6	PD7	10-2
EPP DATA PORT 1	PD0	PD1	PD2	PD3	PD4	PD5	PD6	PD7	10-2
EPP DATA PORT 2	PD0	PD1	PD2	PD3	PD4	PD5	PD6	PD7	10-2
EPP DATA PORT 3	PD0	PD1	PD2	PD3	PD4	PD5	PD6	PD7	10-2

**Note 10-1** These registers are available in all modes.

**Note 10-2** These registers are only available in EPP mode.

**TABLE 10-2: PARALLEL PORT CONNECTOR**

Host Connector	Pin Number	Standard	EPP	ECP
1	83	STROBE#	nWrite	STROBE#
2-9	68-75	PD<0:7>	PData<0:7>	PData<0:7>
10	80	ACK#	Intr	ACK#
11	79	BUSY	nWait	Busy, PeriphAck(3)
12	78	PE	(User Defined)	PError, ACK#Reverse (3)
13	77	SLCT	(User Defined)	Select
14	82	ALF#	nDataStb	nAutoFd, HostAck(3)

**TABLE 10-2: PARALLEL PORT CONNECTOR (CONTINUED)**

Host Connector	Pin Number	Standard	EPP	ECP
15	81	ERROR#	(User Defined)	nFault (1) nPeriphRequest (3)
16	66	INIT#	nRESET	INIT#(1) nReverseRqst(3)
17	67	SLCTIN#	nAddrstrb	nSelectIn(1,3)
(1) = Compatible Mode (3) = High Speed Mode				

**Note 10-3** For the cable interconnection required for ECP support and the Slave Connector pin numbers, refer to the *IEEE 1284 Extended Capabilities Port Protocol and ISA Standard, Rev. 1.14*, July 14, 1993. This document is available from Microsoft.

## 10.1 IBM XT/AT Compatible, Bi-Directional and EPP Modes

### 10.1.1 DATA PORT

#### ADDRESS OFFSET = 00H

The Data Port is located at an offset of '00H' from the base address. The data register is cleared at initialization by RESET. During a WRITE operation, the Data Register latches the contents of the internal data bus. The contents of this register are buffered (non inverting) and output onto the PD0 - PD7 ports. During a READ operation in SPP mode, PD0 - PD7 ports are buffered (not latched) and output to the host CPU.

### 10.1.2 STATUS PORT

#### ADDRESS OFFSET = 01H

The Status Port is located at an offset of '01H' from the base address. The contents of this register are latched for the duration of a read cycle. The bits of the Status Port are defined as follows:

#### Bit 0 TMOU - TIME OUT

This bit is valid in EPP mode only and indicates that a 10 msec time out has occurred on the EPP bus. A logic 0 means that no time out error has occurred; a logic 1 means that a time out error has been detected. This bit is cleared by a RESET. If the TIMEOUT\_SELECT bit (bit 4 of the Parallel Port Mode Register 2, 0xF1 in Logical Device 3 Configuration Registers) is '0', writing a one to this bit clears the TMOU status bit. Writing a zero to this bit has no effect. If the TIMEOUT\_SELECT bit (bit 4 of the Parallel Port Mode Register 2, 0xF1 in Logical Device 3 Configuration Registers) is '1', the TMOU bit is cleared on the trailing edge of a read of the EPP Status Register.

**Bits 1, 2** - are not implemented as register bits, during a read of the Printer Status Register these bits are a low level.

#### Bit 3 nERR – ERROR#

The level on the ERROR# input is read by the CPU as bit 3 of the Printer Status Register. A logic 0 means an error has been detected; a logic 1 means no error has been detected.

#### Bit 4 SLT - Printer Selected Status

The level on the SLCT input is read by the CPU as bit 4 of the Printer Status Register. A logic 1 means the printer is on line; a logic 0 means it is not selected.

#### Bit 5 PE - Paper End

The level on the PE input is read by the CPU as bit 5 of the Printer Status Register. A logic 1 indicates a paper end; a logic 0 indicates the presence of paper.

#### Bit 6 ACK# - Acknowledge

The level on the ACK# input is read by the CPU as bit 6 of the Printer Status Register. A logic 0 means that the printer has received a character and can now accept another. A logic 1 means that it is still processing the last character or has not received the data.

#### Bit 7 nBUSY - nBUSY

The complement of the level on the BUSY input is read by the CPU as bit 7 of the Printer Status Register. A logic 0 in this bit means that the printer is busy and cannot accept a new character. A logic 1 means that it is ready to accept the next character.

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## 10.1.3 CONTROL PORT

### ADDRESS OFFSET = 02H

The Control Port is located at an offset of '02H' from the base address. The Control Register is initialized by the RESET input, bits 0 to 5 only being affected; bits 6 and 7 are hard wired low.

#### Bit 0 STROBE - Strobe

This bit is inverted and output onto the STROBE# output.

#### Bit 1 AUTOFD - Autofeed

This bit is inverted and output onto the nAutoFd output. A logic 1 causes the printer to generate a line feed after each line is printed. A logic 0 means no autofeed.

#### Bit 2 INIT# - Initiate Output

This bit is output onto the INIT# output without inversion.

#### Bit 3 SLCTIN - Printer Select Input

This bit is inverted and output onto the SLCTIN# output. A logic 1 on this bit selects the printer; a logic 0 means the printer is not selected.

#### Bit 4 IRQE - Interrupt Request Enable

The interrupt request enable bit when set to a high level may be used to enable interrupt requests from the Parallel Port to the CPU. An interrupt request is generated on the IRQ port by a positive going ACK# input. When the IRQE bit is programmed low the IRQ is disabled.

#### Bit 5 PCD - PARALLEL CONTROL DIRECTION

Parallel Control Direction is not valid in printer mode. In printer mode, the direction is always out regardless of the state of this bit. In bi-directional, EPP or ECP mode, a logic 0 means that the printer port is in output mode (write); a logic 1 means that the printer port is in input mode (read).

Bits 6 and 7 during a read are a low level, and cannot be written.

## 10.1.4 EPP ADDRESS PORT

### ADDRESS OFFSET = 03H

The EPP Address Port is located at an offset of '03H' from the base address. The address register is cleared at initialization by RESET. During a WRITE operation, the contents of the internal data bus DB0-DB7 are buffered (non inverting) and output onto the PD0 - PD7 ports. An LPC I/O write cycle causes an EPP ADDRESS WRITE cycle to be performed, during which the data is latched for the duration of the EPP write cycle. During a READ operation, PD0 - PD7 ports are read. An LPC I/O read cycle causes an EPP ADDRESS READ cycle to be performed and the data output to the host CPU, the deassertion of ADDRSTB latches the PData for the duration of the read cycle. This register is only available in EPP mode.

## 10.1.5 EPP DATA PORT 0

### ADDRESS OFFSET = 04H

The EPP Data Port 0 is located at an offset of '04H' from the base address. The data register is cleared at initialization by RESET. During a WRITE operation, the contents of the internal data bus DB0-DB7 are buffered (non inverting) and output onto the PD0 - PD7 ports. An LPC I/O write cycle causes an EPP DATA WRITE cycle to be performed, during which the data is latched for the duration of the EPP write cycle. During a READ operation, PD0 - PD7 ports are read. An LPC I/O read cycle causes an EPP READ cycle to be performed and the data output to the host CPU, the deassertion of DATASTB latches the PData for the duration of the read cycle. This register is only available in EPP mode.

## 10.1.6 EPP DATA PORT 1

### ADDRESS OFFSET = 05H

The EPP Data Port 1 is located at an offset of '05H' from the base address. Refer to EPP DATA PORT 0 for a description of operation. This register is only available in EPP mode.

## 10.1.7 EPP DATA PORT 2

### ADDRESS OFFSET = 06H

The EPP Data Port 2 is located at an offset of '06H' from the base address. Refer to EPP DATA PORT 0 for a description of operation. This register is only available in EPP mode.

## 10.1.8 EPP DATA PORT 3

### ADDRESS OFFSET = 07H

The EPP Data Port 3 is located at an offset of '07H' from the base address. Refer to EPP DATA PORT 0 for a description of operation. This register is only available in EPP mode.

## 10.1.9 EPP 1.9 OPERATION

bit When the EPP mode is selected in the configuration register, the standard and bi-directional modes are also available. If no EPP Read, Write or Address cycle is currently executing, then the PDx bus is in the standard or bi-directional mode, and all output signals (STROBE, AUTOFD, INIT) are as set by the SPP Control Port and direction is controlled by PCD of the Control port.

bit In EPP mode, the system timing is closely coupled to the EPP timing. For this reason, a watchdog timer is required to prevent system lockup. The timer indicates if more than 10usec have elapsed from the start of the EPP cycle to nWAIT being deasserted (after command). If a time-out occurs, the current EPP cycle is aborted and the time-out condition is indicated in Status bit 0.

bit During an EPP cycle, if STROBE is active, it overrides the EPP write signal forcing the PDx bus to always be in a write mode and the nWRITE signal to always be asserted.

## 10.1.10 SOFTWARE CONSTRAINTS

Before an EPP cycle is executed, the software must ensure that the control register bit PCD is a logic "0" (i.e., a 04H or 05H should be written to the Control port). If the user leaves PCD as a logic "1", and attempts to perform an EPP write, the chip is unable to perform the write (because PCD is a logic "1") and will appear to perform an EPP read on the parallel bus, no error is indicated.

## 10.1.11 EPP 1.9 WRITE

The timing for a write operation (address or data) is shown in timing diagram EPP Write Data or Address cycle. The chip inserts wait states into the LPC I/O write cycle until it has been determined that the write cycle can complete. The write cycle can complete under the following circumstances:

- If the EPP bus is not ready (nWAIT is active low) when nDATASTB or nADDRSTB goes active then the write can complete when nWAIT goes inactive high.
- If the EPP bus is ready (nWAIT is inactive high) then the chip must wait for it to go active low before changing the state of nDATASTB, nWRITE or nADDRSTB. The write can complete once nWAIT is determined inactive.

### Write Sequence of Operation

1. The host initiates an I/O write cycle to the selected EPP register.
2. If WAIT is not asserted, the chip must wait until WAIT is asserted.
3. The chip places address or data on PData bus, clears PDIR, and asserts nWRITE.
4. Chip asserts nDATASTB or nADDRSTRB indicating that PData bus contains valid information, and the WRITE signal is valid.
5. Peripheral deasserts nWAIT, indicating that any setup requirements have been satisfied and the chip may begin the termination phase of the cycle.
6.
  - a) The chip deasserts nDATASTB or nADDRSTRB, this marks the beginning of the termination phase. If it has not already done so, the peripheral should latch the information byte now.
  - b) The chip latches the data from the internal data bus for the PData bus and drives the sync that indicates that no more wait states are required followed by the TAR to complete the write cycle.
7. Peripheral asserts nWAIT, indicating to the host that any hold time requirements have been satisfied and acknowledging the termination of the cycle.
8. Chip may modify nWRITE and nPDATA in preparation for the next cycle.

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## 10.1.12 EPP 1.9 READ

The timing for a read operation (data) is shown in timing diagram EPP Read Data cycle. The chip inserts wait states into the LPC I/O read cycle until it has been determined that the read cycle can complete. The read cycle can complete under the following circumstances:

- If the EPP bus is not ready (nWAIT is active low) when nDATASTB goes active then the read can complete when nWAIT goes inactive high.
- If the EPP bus is ready (nWAIT is inactive high) then the chip must wait for it to go active low before changing the state of nWRITE or before nDATASTB goes active. The read can complete once nWAIT is determined inactive.

### Read Sequence of Operation

1. The host initiates an I/O read cycle to the selected EPP register.
2. If WAIT is not asserted, the chip must wait until WAIT is asserted.
3. The chip tri-states the PData bus and deasserts nWRITE.
4. Chip asserts nDATASTB or nADDRSTRB indicating that PData bus is tri-stated, PDIR is set and the nWRITE signal is valid.
5. Peripheral drives PData bus valid.
6. Peripheral deasserts nWAIT, indicating that PData is valid and the chip may begin the termination phase of the cycle.
7. The chip latches the data from the PData bus for the internal data bus and deasserts nDATASTB or nADDRSTRB. This marks the beginning of the termination phase.
8. The chip drives the sync that indicates that no more wait states are required and drives valid data onto the LAD[3:0] signals, followed by the TAR to complete the read cycle.
9. Peripheral tri-states the PData bus and asserts nWAIT, indicating to the host that the PData bus is tri-stated.
10. Chip may modify nWRITE, PDIR and nPDATA in preparation for the next cycle.

## 10.1.13 EPP 1.7 OPERATION

When the EPP 1.7 mode is selected in the configuration register, the standard and bi-directional modes are also available. If no EPP Read, Write or Address cycle is currently executing, then the PDx bus is in the standard or bi-directional mode, and all output signals (STROBE, AUTOFD, INIT) are as set by the SPP Control Port and direction is controlled by PCD of the Control port.

In EPP mode, the system timing is closely coupled to the EPP timing. For this reason, a watchdog timer is required to prevent system lockup. The timer indicates if more than 10usec have elapsed from the start of the EPP cycle to the end of the cycle. If a time-out occurs, the current EPP cycle is aborted and the time-out condition is indicated in Status bit 0.

## 10.1.14 SOFTWARE CONSTRAINTS

Before an EPP cycle is executed, the software must ensure that the control register bits D0, D1 and D3 are set to zero. Also, bit D5 (PCD) is a logic "0" for an EPP write or a logic "1" for an EPP read.

## 10.1.15 EPP 1.7 WRITE

The timing for a write operation (address or data) is shown in timing diagram EPP 1.7 Write Data or Address cycle. The chip inserts wait states into the I/O write cycle when nWAIT is active low during the EPP cycle. This can be used to extend the cycle time. The write cycle can complete when nWAIT is inactive high.

### Write Sequence of Operation

- The host sets PDIR bit in the control register to a logic "0". This asserts nWRITE.
- The host initiates an I/O write cycle to the selected EPP register.
- The chip places address or data on PData bus.
- Chip asserts nDATASTB or nADDRSTRB indicating that PData bus contains valid information, and the WRITE signal is valid.
- If nWAIT is asserted, the chip inserts wait states into I/O write cycle until the peripheral deasserts nWAIT or a time-out occurs.
- The chip drives the final sync, deasserts nDATASTB or nADDRSTRB and latches the data from the internal data bus for the PData bus.
- Chip may modify nWRITE, PDIR and nPDATA in preparation of the next cycle.

## 10.1.16 EPP 1.7 READ

The timing for a read operation (data) is shown in timing diagram EPP 1.7 Read Data cycle. The chip inserts wait states into the I/O read cycle when nWAIT is active low during the EPP cycle. This can be used to extend the cycle time. The read cycle can complete when nWAIT is inactive high.

### Read Sequence of Operation

- The host sets PDIR bit in the control register to a logic “1”. This deasserts nWRITE and tri-states the PData bus.
- The host initiates an I/O read cycle to the selected EPP register.
- Chip asserts nDATASTB or nADDRSTRB indicating that PData bus is tri-stated, PDIR is set and the nWRITE signal is valid.
- If nWAIT is asserted, the chip inserts wait states into the I/O read cycle until the peripheral deasserts nWAIT or a time-out occurs.
- The Peripheral drives PData bus valid.
- The Peripheral deasserts nWAIT, indicating that PData is valid and the chip may begin the termination phase of the cycle.
- The chip drives the final sync and deasserts nDATASTB or nADDRSTRB.
- Peripheral tri-states the PData bus.
- Chip may modify nWRITE, PDIR and nPDATA in preparation of the next cycle.

**TABLE 10-3: EPP PIN DESCRIPTIONS**

EPP Signal	EPP Name	Type	EPP Description
nWRITE	nWrite	O	This signal is active low. It denotes a write operation.
PD<0:7>	Address/Data	I/O	Bi-directional EPP byte wide address and data bus.
INTR	Interrupt	I	This signal is active high and positive edge triggered. (Pass through with no inversion, Same as SPP).
nWAIT	nWait	I	This signal is active low. It is driven inactive as a positive acknowledgement from the device that the transfer of data is completed. It is driven active as an indication that the device is ready for the next transfer.
nDATASTB	nData Strobe	O	This signal is active low. It is used to denote data read or write operation.
nRESET	nReset	O	This signal is active low. When driven active, the EPP device is reset to its initial operational mode.
nADDRSTB	Address Strobe	O	This signal is active low. It is used to denote address read or write operation.
PE	Paper End	I	Same as SPP mode.
SLCT	Printer Selected Status	I	Same as SPP mode.
nERR	Error	I	Same as SPP mode.
<b>Note 10-4</b>	SPP and EPP can use 1 common register.		
<b>Note 10-5</b>	nWrite is the only EPP output that can be over-riden by SPP control port during an EPP cycle. For correct EPP read cycles, PCD is required to be a low.		

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## 10.2 Extended Capabilities Parallel Port

ECP provides a number of advantages, some of which are listed below. The individual features are explained in greater detail in the remainder of this section.

High performance half-duplex forward and reverse channel Interlocked handshake, for fast reliable transfer  
 Optional single byte RLE compression for improved throughput (64:1)  
 Channel addressing for low-cost peripherals  
 Maintains link and data layer separation  
 Permits the use of active output drivers  
 permits the use of adaptive signal timing  
 Peer-to-peer capability.

### 10.2.1 VOCABULARY

The following terms are used in this document:

assert: When a signal asserts it transitions to a “true” state, when a signal deasserts it transitions to a “false” state.

forward: Host to Peripheral communication.

reverse: Peripheral to Host communication

Pword: A port word; equal in size to the width of the LPC interface. For this implementation, PWord is always 8 bits.

1 A high level

0 A low level

These terms may be considered synonymous:

PeriphClk, ACK#

HostAck, nAutoFd

PeriphAck, Busy

nPeriphRequest, nFault

nReverseRequest, INIT#

ACK#Reverse, PError

Xflag, Select

ECPMode, nSelectIn

HostClk, STROBE#

Reference Document: *IEEE 1284 Extended Capabilities Port Protocol and ISA Interface Standard*, Rev 1.14, July 14, 1993. This document is available from Microsoft.

**TABLE 10-4: BIT MAP OF THE EXTENDED PARALLEL PORT REGISTERS**

	D7	D6	D5	D4	D3	D2	D1	D0	Note
data	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0	
ecpAFifo	Addr/RLE	Address or RLE field							10-7
dsr	nBusy	ACK#	PError	Select	nFault	0	0	0	10-6
dcr	0	0	Direction	ackIntEn	Selectio n	INIT#	autofd	strobe	10-6
cFifo	Parallel Port Data FIFO								10-7
ecpDFifo	ECP Data FIFO								10-7
tFifo	Test FIFO								10-7
cnfgA	0	0	0	1	0	0	0	0	
cnfgB	compress	intrValue	Parallel Port IRQ			Parallel Port DMA			
ecr	MODE			nErrIntrEn	dmaEn	servicel ntr	full	empty	
<b>Note 10-6</b>	These registers are available in all modes.								
<b>Note 10-7</b>	All FIFOs use one common 16 byte FIFO.								
<b>Note 10-8</b>	The ECP Parallel Port Config Reg B reflects the IRQ and DMA channel selected by the Configuration Registers.								



## 10.2.2 ECP IMPLEMENTATION STANDARD

This specification describes the standard interface to the Extended Capabilities Port (ECP). All LPC devices supporting ECP must meet the requirements contained in this section or the port will not be supported by Microsoft. For a description of the ECP Protocol, please refer to the *IEEE 1284 Extended Capabilities Port Protocol and ISA Interface Standard, Rev. 1.14*, July 14, 1993. This document is available from Microsoft.

### Description

The port is software and hardware compatible with existing parallel ports so that it may be used as a standard LPT port if ECP is not required. The port is designed to be simple and requires a small number of gates to implement. It does not do any "protocol" negotiation, rather it provides an automatic high burst-bandwidth channel that supports DMA for ECP in both the forward and reverse directions.

Small FIFOs are employed in both forward and reverse directions to smooth data flow and improve the maximum bandwidth requirement. The size of the FIFO is 16 bytes deep. The port supports an automatic handshake for the standard parallel port to improve compatibility mode transfer speed.

The port also supports run length encoded (RLE) decompression (required) in hardware. Compression is accomplished by counting identical bytes and transmitting an RLE byte that indicates how many times the next byte is to be repeated. Decompression simply intercepts the RLE byte and repeats the following byte the specified number of times. Hardware support for compression is optional.

**TABLE 10-5: ECP PIN DESCRIPTIONS**

Name	Type	Description
STROBE#	O	During write operations STROBE# registers data or address into the slave on the asserting edge (handshakes with Busy).
PData 7:0	I/O	Contains address or data or RLE data.
ACK#	I	Indicates valid data driven by the peripheral when asserted. This signal handshakes with nAutoFd in reverse.
PeriphAck (Busy)	I	This signal deasserts to indicate that the peripheral can accept data. This signal handshakes with STROBE# in the forward direction. In the reverse direction this signal indicates whether the data lines contain ECP command information or data. The peripheral uses this signal to flow control in the forward direction. It is an "interlocked" handshake with STROBE#. PeriphAck also provides command information in the reverse direction.
PError (ACK#Reverse)	I	Used to acknowledge a change in the direction the transfer (asserted = forward). The peripheral drives this signal low to acknowledge nReverseRequest. It is an "interlocked" handshake with nReverseRequest. The host relies upon ACK#Reverse to determine when it is permitted to drive the data bus.
Select	I	Indicates printer on line.
nAutoFd (HostAck)	O	Requests a byte of data from the peripheral when asserted, handshaking with ACK# in the reverse direction. In the forward direction this signal indicates whether the data lines contain ECP address or data. The host drives this signal to flow control in the reverse direction. It is an "interlocked" handshake with ACK#. HostAck also provides command information in the forward phase.
nFault (nPeriphRequest)	I	Generates an error interrupt when asserted. This signal provides a mechanism for peer-to-peer communication. This signal is valid only in the forward direction. During ECP Mode the peripheral is permitted (but not required) to drive this pin low to request a reverse transfer. The request is merely a "hint" to the host; the host has ultimate control over the transfer direction. This signal would be typically used to generate an interrupt to the host CPU.
INIT#	O	Sets the transfer direction (asserted = reverse, deasserted = forward). This pin is driven low to place the channel in the reverse direction. The peripheral is only allowed to drive the bidirectional data bus while in ECP Mode and HostAck is low and nSelectIn is high.
nSelectIn	O	Always deasserted in ECP mode.

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## 10.2.3 REGISTER DEFINITIONS

The register definitions are based on the standard IBM addresses for LPT. All of the standard printer ports are supported. The additional registers attach to an upper bit decode of the standard LPT port definition to avoid conflict with standard ISA devices. The port is equivalent to a generic parallel port interface and may be operated in that mode. The port registers vary depending on the mode field in the ecr. [Table 10-6](#) lists these dependencies. Operation of the devices in modes other than those specified is undefined.

**TABLE 10-6: ECP REGISTER DEFINITIONS**

Name	Address (10-9)	ECP Modes	Function
data	+000h R/W	000-001	Data Register
ecpAFifo	+000h R/W	011	ECP FIFO (Address)
dsr	+001h R/W	All	Status Register
dcr	+002h R/W	All	Control Register
cFifo	+400h R/W	010	Parallel Port Data FIFO
ecpDFifo	+400h R/W	011	ECP FIFO (DATA)
tFifo	+400h R/W	110	Test FIFO
cnfgA	+400h R	111	Configuration Register A
cnfgB	+401h R/W	111	Configuration Register B
ecr	+402h R/W	All	Extended Control Register

**Note 10-9** These addresses are added to the parallel port base address as selected by configuration register or jumpers.

**Note 10-10** All addresses are qualified with AEN. Refer to the AEN pin definition.

**TABLE 10-7: MODE DESCRIPTIONS**

Mode	Description
000	SPP mode
001	PS/2 Parallel Port mode
010	Parallel Port Data FIFO mode
011	ECP Parallel Port mode
100	EPP mode (If this option is enabled in the configuration registers)
101	Reserved
110	Test mode
111	Configuration mode

\*Refer to ECR Register Description

## 10.2.4 DATA AND ECPAFIFO PORT

### ADDRESS OFFSET = 00H

Modes 000 and 001 (Data Port)

The Data Port is located at an offset of '00H' from the base address. The data register is cleared at initialization by RESET. During a WRITE operation, the Data Register latches the contents of the data bus. The contents of this register are buffered (non inverting) and output onto the PD0 - PD7 ports. During a READ operation, PD0 - PD7 ports are read and output to the host CPU.

Mode 011 (ECP FIFO - Address/RLE)

A data byte written to this address is placed in the FIFO and tagged as an ECP Address/RLE. The hardware at the ECP port transmits this byte to the peripheral automatically. The operation of this register is only defined for the forward direction (direction is 0). Refer to [TABLE 22-12: on page 218](#), located in [Section 22.0, "Timing Diagrams," on page 208](#) of this data sheet.

## 10.2.5 DEVICE STATUS REGISTER (DSR)

### ADDRESS OFFSET = 01H

The Status Port is located at an offset of '01H' from the base address. Bits 0 - 2 are not implemented as register bits, during a read of the Printer Status Register these bits are a low level. The bits of the Status Port are defined as follows:

#### Bit 3 nFault

The level on the nFault input is read by the CPU as bit 3 of the Device Status Register.

#### Bit 4 Select

The level on the Select input is read by the CPU as bit 4 of the Device Status Register.

#### Bit 5 PError

The level on the PError input is read by the CPU as bit 5 of the Device Status Register. Printer Status Register.

#### Bit 6 ACK#

The level on the ACK# input is read by the CPU as bit 6 of the Device Status Register.

#### Bit 7 nBusy

The complement of the level on the BUSY input is read by the CPU as bit 7 of the Device Status Register.

## 10.2.6 DEVICE CONTROL REGISTER (DCR)

### ADDRESS OFFSET = 02H

The Control Register is located at an offset of '02H' from the base address. The Control Register is only valid after activation and is initialized to zero by the RESET input, bits 0 to 5 only being affected; bits 6 and 7 are hard wired low.

#### Bit 0 STROBE - STROBE

This bit is inverted and output onto the STROBE# output.

#### Bit 1 AUTOFD - AUTOFEED

This bit is inverted and output onto the nAutoFd output. A logic 1 causes the printer to generate a line feed after each line is printed. A logic 0 means no autofeed.

#### Bit 2 INIT# - INITIATE OUTPUT

This bit is output onto the INIT# output without inversion.

#### Bit 3 SELECTIN

This bit is inverted and output onto the SLCTIN# output. A logic 1 on this bit selects the printer; a logic 0 means the printer is not selected.

#### Bit 4 ackIntEn - INTERRUPT REQUEST ENABLE

The interrupt request enable bit when set to a high level may be used to enable interrupt requests from the Parallel Port to the CPU due to a low to high transition on the ACK# input. Refer to the description of the interrupt under Operation, Interrupts.

#### Bit 5 DIRECTION

If mode=000 or mode=010, this bit has no effect and the direction is always out regardless of the state of this bit. In all other modes, Direction is valid and a logic 0 means that the printer port is in output mode (write); a logic 1 means that the printer port is in input mode (read).

**Bits 6 and 7 during a read are a low level, and cannot be written.**

cFifo (Parallel Port Data FIFO)

### ADDRESS OFFSET = 400h

Mode = 010

Bytes written or DMAed from the system to this FIFO are transmitted by a hardware handshake to the peripheral using the standard parallel port protocol. Transfers to the FIFO are byte aligned. This mode is only defined for the forward direction.

ecpDFifo (ECP Data FIFO)

### ADDRESS OFFSET = 400H

Mode = 011

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Bytes written or DMAed from the system to this FIFO, when the direction bit is 0, are transmitted by a hardware handshake to the peripheral using the ECP parallel port protocol. Transfers to the FIFO are byte aligned.

Data bytes from the peripheral are read under automatic hardware handshake from ECP into this FIFO when the direction bit is 1. Reads or DMA's from the FIFO will return bytes of ECP data to the system.

tFifo (Test FIFO Mode)

**ADDRESS OFFSET = 400H**

Mode = 110

Data bytes may be read, written or DMAed to or from the system to this FIFO in any direction. Data in the tFIFO will not be transmitted to the parallel port lines using a hardware protocol handshake. However, data in the tFIFO may be displayed on the parallel port data lines.

The tFIFO will not stall when overwritten or underrun. If an attempt is made to write data to a full tFIFO, the new data is not accepted into the tFIFO. If an attempt is made to read data from an empty tFIFO, the last data byte is re-read again. The full and empty bits must always keep track of the correct FIFO state. The tFIFO will transfer data at the maximum ISA rate so that software may generate performance metrics.

The FIFO size and interrupt threshold can be determined by writing bytes to the FIFO and checking the full and serviceIntr bits.

The writeIntrThreshold can be determined by starting with a full tFIFO, setting the direction bit to 0 and emptying it a byte at a time until serviceIntr is set. This may generate a spurious interrupt, but will indicate that the threshold has been reached.

The readIntrThreshold can be determined by setting the direction bit to 1 and filling the empty tFIFO a byte at a time until serviceIntr is set. This may generate a spurious interrupt, but will indicate that the threshold has been reached.

Data bytes are always read from the head of tFIFO regardless of the value of the direction bit. For example if 44h, 33h, 22h is written to the FIFO, then reading the tFIFO will return 44h, 33h, 22h in the same order as was written.

cnfgA (Configuration Register A)

**ADDRESS OFFSET = 400H**

Mode = 111

This register is a read only register. When read, 10H is returned. This indicates to the system that this is an 8-bit implementation. (PWord = 1 byte)

cnfgB (Configuration Register B)

**ADDRESS OFFSET = 401H**

Mode = 111

## Bit 7 compress

This bit is read only. During a read it is a low level. This means that this chip does not support hardware RLE compression. It does support hardware de-compression.

## Bit 6 intrValue

Returns the value of the interrupt to determine possible conflicts.

## Bit [5:3] Parallel Port IRQ (read-only)

to [Table 10-9 on page 94](#).

## Bits [2:0] Parallel Port DMA (read-only)

to [Table 10-10 on page 94](#).

ecr (Extended Control Register)

**ADDRESS OFFSET = 402H**

Mode = all

This register controls the extended ECP parallel port functions.

## Bits 7,6,5

These bits are Read/Write and select the Mode.

## Bit 4 nErrIntrEn

Read/Write (Valid only in ECP Mode)

- 1: Disables the interrupt generated on the asserting edge of nFault.
- 0: Enables an interrupt pulse on the high to low edge of nFault. Note that an interrupt will be generated if nFault is asserted (interrupting) and this bit is written from a 1 to a 0. This prevents interrupts from being lost in the time between the read of the ecr and the write of the ecr.

## Bit 3 dmaEn

Read/Write

- 1: Enables DMA (DMA starts when serviceIntr is 0).
- 0: Disables DMA unconditionally.

## Bit 2 serviceIntr

Read/Write

- 1: Disables DMA and all of the service interrupts.
- 0: Enables one of the following 3 cases of interrupts. Once one of the 3 service interrupts has occurred serviceIntr bit shall be set to a 1 by hardware. It must be reset to 0 to re-enable the interrupts. Writing this bit to a 1 will not cause an interrupt.

case dmaEn=1:

During DMA (this bit is set to a 1 when terminal count is reached).

case dmaEn=0 direction=0:

This bit shall be set to 1 whenever there are writeIntrThreshold or more bytes free in the FIFO.

case dmaEn=0 direction=1:

This bit shall be set to 1 whenever there are readIntrThreshold or more valid bytes to be read from the FIFO.

## Bit 1 full

Read only

- 1: The FIFO cannot accept another byte or the FIFO is completely full.
- 0: The FIFO has at least 1 free byte.

## Bit 0 empty

Read only

- 1: The FIFO is completely empty.
- 0: The FIFO contains at least 1 byte of data.

**TABLE 10-8: EXTENDED CONTROL REGISTER (A)**

R/W	Mode
000:	Standard Parallel Port Mode. In this mode the FIFO is reset and common drain drivers are used on the control lines (STROBE#, nAutoFd, INIT# and nSelectIn). Setting the direction bit will not tri-state the output drivers in this mode.
001:	PS/2 Parallel Port Mode. Same as above except that direction may be used to tri-state the data lines and reading the data register returns the value on the data lines and not the value in the data register. All drivers have active pull-ups (push-pull).
010:	Parallel Port FIFO Mode. This is the same as 000 except that bytes are written or DMAed to the FIFO. FIFO data is automatically transmitted using the standard parallel port protocol. Note that this mode is only useful when direction is 0. All drivers have active pull-ups (push-pull).
011:	ECP Parallel Port Mode. In the forward direction (direction is 0) bytes placed into the ecpDFifo and bytes written to the ecpAFifo are placed in a single FIFO and transmitted automatically to the peripheral using ECP Protocol. In the reverse direction (direction is 1) bytes are moved from the ECP parallel port and packed into bytes in the ecpDFifo. All drivers have active pull-ups (push-pull).
100:	Selects EPP Mode: In this mode, EPP is selected if the EPP supported option is selected in configuration register L3-CRF0. All drivers have active pull-ups (push-pull).
101:	Reserved

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**TABLE 10-8: EXTENDED CONTROL REGISTER (A) (CONTINUED)**

R/W	Mode
110:	Test Mode. In this mode the FIFO may be written and read, but the data will not be transmitted on the parallel port. All drivers have active pull-ups (push-pull).
111:	Configuration Mode. In this mode the cnfgA, cnfgB registers are accessible at 0x400 and 0x401. All drivers have active pull-ups (push-pull).

**TABLE 10-9: EXTENDED CONTROL REGISTER (B)**

IRQ Selected	Config Reg B Bits 5:3
15	110
14	101
11	100
10	011
9	010
7	001
5	111
All others	000

**APPLICATION NOTE:** The cnfgB register reads back the IRQ selected in the Interrupt Select configuration register (offset 70h). This configuration register does not affect the SERIRQ channel on which the Parallel Port interrupt appears. The interrupt channel is assigned to the Parallel Port in the LPC Logical Device as shown in [Table 7-6, "SIRQ Interrupt Configuration Register Map"](#). If this IRQ field in cnfgB is required, then software must insure that the Interrupt Select configuration register and the SIRQ Interrupt Configuration table are set to compatible values.

**TABLE 10-10: EXTENDED CONTROL REGISTER (C)**

IRQ Selected	Config Reg B Bits 5:3
3	011
2	010
1	001
All others	000

**APPLICATION NOTE:** The cnfgB register reads back the DMA channel selected in the DMA Channel Select configuration register (offset 74h). This configuration register does not affect the DMA channel on which the Parallel Port DMA transfer appears. The DMA channel is assigned to the Parallel Port in the LPC Logical Device as shown in [Table 7-4, "DMA Configuration Register Map"](#). If this DMA field in cnfgB is required, then software must insure that the DMA Channel Select configuration register and the DMA Configuration table are set to compatible values.

## 10.2.7 OPERATION

### Mode Switching/Software Control

Software will execute P1284 negotiation and all operation prior to a data transfer phase under programmed I/O control (mode 000 or 001). Hardware provides an automatic control line handshake, moving data between the FIFO and the ECP port only in the data transfer phase (modes 011 or 010).

Setting the mode to 011 or 010 will cause the hardware to initiate data transfer.

If the port is in mode 000 or 001 it may switch to any other mode. If the port is not in mode 000 or 001 it can only be switched into mode 000 or 001. The direction can only be changed in mode 001.

Once in an extended forward mode the software should wait for the FIFO to be empty before switching back to mode 000 or 001. In this case all control signals will be deasserted before the mode switch. In an ecp reverse mode the software waits for all the data to be read from the FIFO before changing back to mode 000 or 001. Since the automatic hardware ecp reverse handshake only cares about the state of the FIFO it may have acquired extra data which will be discarded. It may in fact be in the middle of a transfer when the mode is changed back to 000 or 001. In this case the port will deassert nAutoFd independent of the state of the transfer. The design shall not cause glitches on the handshake signals if the software meets the constraints above.

## 10.2.7.1 ECP Operation

Prior to ECP operation the Host must negotiate on the parallel port to determine if the peripheral supports the ECP protocol. This is a somewhat complex negotiation carried out under program control in mode 000.

After negotiation, it is necessary to initialize some of the port bits. The following are required:

Set Direction = 0, enabling the drivers.

Set strobe = 0, causing the STROBE# signal to default to the deasserted state.

Set autoFd = 0, causing the nAutoFd signal to default to the deasserted state.

Set mode = 011 (ECP Mode)

ECP address/RLE bytes or data bytes may be sent automatically by writing the ecpAFifo or ecpDFifo respectively.

Note all FIFO data transfers are byte wide and byte aligned. Address/RLE transfers are byte-wide and only allowed in the forward direction.

The host may switch directions by first switching to mode = 001, negotiating for the forward or reverse channel, setting direction to 1 or 0, then setting mode = 011. When direction is 1 the hardware shall handshake for each ECP read data byte and attempt to fill the FIFO. Bytes may then be read from the ecpDFifo as long as it is not empty.

ECP transfers may also be accomplished (albeit slowly) by handshaking individual bytes under program control in mode = 001, or 000.

## 10.2.8 TERMINATION FROM ECP MODE

Termination from ECP Mode is similar to the termination from Nibble/Byte Modes. The host is permitted to terminate from ECP Mode only in specific well-defined states. The termination can only be executed while the bus is in the forward direction. To terminate while the channel is in the reverse direction, it must first be transitioned into the forward direction.

## 10.2.9 COMMAND/DATA

ECP Mode supports two advanced features to improve the effectiveness of the protocol for some applications. The features are implemented by allowing the transfer of normal 8 bit data or 8 bit commands.

When in the forward direction, normal data is transferred when HostAck is high and an 8 bit command is transferred when HostAck is low.

The most significant bit of the command indicates whether it is a run-length count (for compression) or a channel address.

When in the reverse direction, normal data is transferred when PeriphAck is high and an 8 bit command is transferred when PeriphAck is low. The most significant bit of the command is always zero. Reverse channel addresses are seldom used and may not be supported in hardware.

**TABLE 10-11: CHANNEL/DATA COMMANDS SUPPORTED IN ECP MODE**

Forward Channel Commands (HostAck Low) Reverse Channel Commands (PeriphAck Low)	
D7	D[6:0]
0	Run-Length Count (0-127) (mode 0011 0X00 only)
1	Channel Address (0-127)

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## 10.2.10 DATA COMPRESSION

The ECP port supports run length encoded (RLE) decompression in hardware and can transfer compressed data to a peripheral. Run length encoded (RLE) compression in hardware is not supported. To transfer compressed data in ECP mode, the compression count is written to the `ecpAFifo` and the data byte is written to the `ecpDFifo`.

Compression is accomplished by counting identical bytes and transmitting an RLE byte that indicates how many times the next byte is to be repeated. Decompression simply intercepts the RLE byte and repeats the following byte the specified number of times. When a run-length count is received from a peripheral, the subsequent data byte is replicated the specified number of times. A run-length count of zero specifies that only one byte of data is represented by the next data byte, whereas a run-length count of 127 indicates that the next byte should be expanded to 128 bytes. To prevent data expansion, however, run-length counts of zero should be avoided.

## 10.2.11 PIN DEFINITION

The drivers for `STROBE#`, `nAutoFd`, `INIT#` and `nSelectIn` are open-drain in mode 000 and are push-pull in all other modes.

## 10.2.12 LPC CONNECTIONS

The interface can never stall causing the host to hang. The width of data transfers is strictly controlled on an I/O address basis per this specification. All FIFO-DMA transfers are byte wide, byte aligned and end on a byte boundary. (The `PWord` value can be obtained by reading Configuration Register A, `cnfgA`, described in the next section). Single byte wide transfers are always possible with standard or PS/2 mode using program control of the control signals.

## 10.2.13 INTERRUPTS

The interrupts are enabled by `serviceIntr` in the `ecr` register.

`serviceIntr = 1` Disables the DMA and all of the service interrupts.

`serviceIntr = 0` Enables the selected interrupt condition. If the interrupting condition is valid, then the interrupts generated immediately when this bit is changed from a 1 to a 0. This can occur during Programmed I/O if the number of bytes removed or added from/to the FIFO does not cross the threshold.

An interrupt is generated when:

1. For DMA transfers: When `serviceIntr` is 0, `dmaEn` is 1 and the DMA TC cycle is received.
2. For Programmed I/O:
3. When `serviceIntr` is 0, `dmaEn` is 0, `direction` is 0 and there are `writeIntrThreshold` or more free bytes in the FIFO. Also, an interrupt is generated when `serviceIntr` is cleared to 0 whenever there are `writeIntrThreshold` or more free bytes in the FIFO.
4. When `serviceIntr` is 0, `dmaEn` is 0, `direction` is 1 and there are `readIntrThreshold` or more bytes in the FIFO. Also, an interrupt is generated when `serviceIntr` is cleared to 0 whenever there are `readIntrThreshold` or more bytes in the FIFO.
5. When `nErrIntrEn` is 0 and `nFault` transitions from high to low or when `nErrIntrEn` is set from 1 to 0 and `nFault` is asserted.
6. When `ackIntEn` is 1 and the `ACK#` signal transitions from a low to a high.

## 10.2.14 FIFO OPERATION

The FIFO threshold is set in the chip configuration registers. All data transfers to or from the parallel port can proceed in DMA or Programmed I/O (non-DMA) mode as indicated by the selected mode. The FIFO is used by selecting the Parallel Port FIFO mode or ECP Parallel Port Mode. (FIFO test mode will be addressed separately.) After a reset, the FIFO is disabled. Each data byte is transferred by a Programmed I/O cycle or DMA cycle depending on the selection of DMA or Programmed I/O mode.

The following paragraphs detail the operation of the FIFO flow control. In these descriptions, `<threshold>` ranges from 1 to 16. The parameter `FIFOTHR`, which the user programs, is one less and ranges from 0 to 15.

A low threshold value (i.e. 2) results in longer periods of time between service requests, but requires faster servicing of the request for both read and write cases. The host must be very responsive to the service request. This is the desired case for use with a "fast" system. A high value of threshold (i.e. 12) is used with a "sluggish" system by affording a long latency period after a service request, but results in more frequent service requests.



## 10.2.15 DMA TRANSFERS

DMA transfers are always to or from the ecpDFifo, tFifo or CFifo. DMA utilizes the standard PC DMA services. To use the DMA transfers, the host first sets up the direction and state as in the programmed I/O case. Then it programs the DMA controller in the host with the desired count and memory address. Lastly it sets dmaEn to 1 and serviceIntr to 0. The ECP requests DMA transfers from the host by encoding the LDRQ# pin. The DMA will empty or fill the FIFO using the appropriate direction and mode. When the terminal count in the DMA controller is reached, an interrupt is generated and serviceIntr is asserted, disabling DMA. In order to prevent possible blocking of refresh requests a DMA cycle shall not be requested for more than 32 DMA cycles in a row. The FIFO is enabled directly by the host initiating a DMA cycle for the requested channel, and addresses need not be valid. An interrupt is generated when a TC cycle is received. (Note: The only way to properly terminate DMA transfers is with a TC cycle.)

DMA may be disabled in the middle of a transfer by first disabling the host DMA controller. Then setting serviceIntr to 1, followed by setting dmaEn to 0, and waiting for the FIFO to become empty or full. Restarting the DMA is accomplished by enabling DMA in the host, setting dmaEn to 1, followed by setting serviceIntr to 0.

## 10.2.16 DMA MODE - TRANSFERS FROM THE FIFO TO THE HOST

In the reverse mode, the peripheral may not continue to fill the FIFO if it runs out of data to transfer, even if the chip continues to request more data from the peripheral.)

The ECP requests a DMA cycle whenever there is data in the FIFO. The DMA controller must respond to the request by reading data from the FIFO. The ECP stops requesting DMA cycles when the FIFO becomes empty or when a TC cycle is received, indicating that no more data is required. If the ECP stops requesting DMA cycles due to the FIFO going empty, then a DMA cycle is requested again as soon as there is one byte in the FIFO. If the ECP stops requesting DMA cycles due to the TC cycle, then a DMA cycle is requested again when there is one byte in the FIFO, and serviceIntr has been re-enabled.

## 10.2.17 PROGRAMMED I/O MODE OR NON-DMA MODE

The ECP or parallel port FIFOs may also be operated using interrupt driven programmed I/O. Software can determine the writeIntrThreshold, readIntrThreshold, and FIFO depth by accessing the FIFO in Test Mode.

Programmed I/O transfers are to the ecpDFifo at 400H and ecpAFifo at 000H or from the ecpDFifo located at 400H, or to/from the tFifo at 400H. To use the programmed I/O transfers, the host first sets up the direction and state, sets dmaEn to 0 and serviceIntr to 0.

The ECP requests programmed I/O transfers from the host by activating the interrupt. The programmed I/O will empty or fill the FIFO using the appropriate direction and mode.

**Note 10-11** A threshold of 16 is equivalent to a threshold of 15. These two cases are treated the same.

## 10.2.18 PROGRAMMED I/O - TRANSFERS FROM THE FIFO TO THE HOST

In the reverse direction an interrupt occurs when serviceIntr is 0 and readIntrThreshold bytes are available in the FIFO. If at this time the FIFO is full it can be emptied completely in a single burst, otherwise readIntrThreshold bytes may be read from the FIFO in a single burst.

readIntrThreshold = (16-<threshold>) data bytes in FIFO

An interrupt is generated when serviceIntr is 0 and the number of bytes in the FIFO is greater than or equal to (16-<threshold>). (If the threshold = 12, then the interrupt is set whenever there are 4-16 bytes in the FIFO). The host must respond to the request by reading data from the FIFO. This process is repeated until the last byte is transferred out of the FIFO. If at this time the FIFO is full, it can be completely emptied in a single burst, otherwise a minimum of (16-<threshold>) bytes may be read from the FIFO in a single burst.

## 10.2.19 PROGRAMMED I/O - TRANSFERS FROM THE HOST TO THE FIFO

In the forward direction an interrupt occurs when serviceIntr is 0 and there are writeIntrThreshold or more bytes free in the FIFO. At this time if the FIFO is empty it can be filled with a single burst before the empty bit needs to be re-read. Otherwise it may be filled with writeIntrThreshold bytes.

writeIntrThreshold = (16-<threshold>) free bytes in FIFO

An interrupt is generated when serviceIntr is 0 and the number of bytes in the FIFO is less than or equal to <threshold>. (If the threshold = 12, then the interrupt is set whenever there are 12 or less bytes of data in the FIFO.) The host must respond to the request by writing data to the FIFO. If at this time the FIFO is empty, it can be completely filled in a single burst, otherwise a minimum of (16-<threshold>) bytes may be written to the FIFO in a single burst. This process is repeated until the last byte is transferred into the FIFO.

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## 11.0 FLOPPY DISK CONTROLLER

The Floppy Disk controller (FDC) provides the interface between a host microprocessor and the floppy disk drives. The FDC integrates the functions of the Formatter/Controller, Digital data Separator, Write Precompensation and Data Rate Selection logic for an IBM XT/AT compatible FDC. The true CMOS 765B core maintains 100% IBM PC XT/AT compatibility in addition to providing data overflow and underflow protection. SCH5627P supports one floppy drive directly (see [Section 11.12, "Floppy Drive Presence Detection," on page 133](#)).

The FDC is compatible to the 82077AA using Microchip's proprietary floppy disk controller core.

**Note:** Although the SCH5627P supports only a single floppy drive, references to the second drive are retained in this chapter for reference.

### 11.1 FDC Internal Registers

The Floppy Disk Controller contains eight internal registers which facilitate the interfacing between the host microprocessor and the disk drive. [Table 11-1](#) shows the addresses required to access these registers. Registers other than the ones shown are not supported. The rest of the description assumes that the primary addresses have been selected.

(Shown with base addresses of 3F0 and 370.)

**TABLE 11-1: STATUS, DATA AND CONTROL REGISTERS**

Primary Address	Secondary Address	R/W	Register
3F0	370	R	Status Register A (SRA)
3F1	371	R	Status Register B (SRB)
3F2	372	R/W	Digital Output Register (DOR)
3F3	373	R/W	Tape Drive Register (TDR)
3F4	374	R	Main Status Register (MSR)
3F4	374	W	Data Rate Select Register (DSR)
3F5	375	R/W	Data (FIFO)
3F6	376		Reserved
3F7	377	R	Digital Input Register (DIR)
3F7	377	W	Configuration Control Register (CCR)

#### 11.1.1 STATUS REGISTER A (SRA)

##### Address 3F0 READ ONLY

This register is read-only and monitors the state of the internal interrupt signal and several disk interface pins in PS/2 and Model 30 modes. The SRA can be accessed at any time when in PS/2 mode. In the PC/AT mode the data bus pins D0 – D7 are held in a high impedance state for a read of address 3F0.

##### 11.1.1.1 PS/2 Mode

	7	6	5	4	3	2	1	0
	INT PENDING	nDRV2	STEP	TRK0#	HDSEL	nINDX	nWP	DIR
RESET COND.	0	1	0	N/A	0	N/A	N/A	0

##### Bit 0 DIRECTION

Active high status indicating the direction of head movement. A logic "1" indicates inward direction; a logic "0" indicates outward direction.

##### Bit 1 nWRITE PROTECT

Active low status of the WRITE PROTECT disk interface input. A logic "0" indicates that the disk is write protected.

##### Bit 2 INDEX#

Active low status of the INDEX disk interface input.

##### Bit 3 HEAD SELECT

Active high status of the HDSEL disk interface input. A logic "1" selects side 1 and a logic "0" selects side 0.

## Bit 4 nTRACK 0

Active low status of the TRK0 disk interface input.

## Bit 5 STEP

Active high status of the STEP output disk interface output pin.

## Bit 6 nDRV2

**Note:** This function is not supported. This bit is always read as “1”.

## Bit 7 INTERRUPT PENDING

Active high bit indicating the state of the Floppy Disk Interrupt output.

### 11.1.1.2 PS/2 Model 30 Mode

	7	6	5	4	3	2	1	0
	INT PENDING	DRQ	STEP F/F	TRK0	HDSEL#H DSEL#HD SEL#	INDX	WP	DIR#
RESET COND.	0	0	0	N/A	1	N/A	N/A	1

## Bit 0 DIRECTION

Active low status indicating the direction of head movement. A logic “0” indicates inward direction; a logic “1” indicates outward direction.

## Bit 1 WRITE PROTECT

Active high status of the WRITE PROTECT disk interface input. A logic “1” indicates that the disk is write protected.

## Bit 2 INDEX

Active high status of the INDEX disk interface input.

## Bit 3 HEAD SELECT

Active low status of the HDSEL disk interface input. A logic “0” selects side 1 and a logic “1” selects side 0.

## Bit 4 TRACK 0

Active high status of the TRK0 disk interface input.

## Bit 5 STEP

Active high status of the latched STEP disk interface output pin. This bit is latched with the STEP output going active, and is cleared with a read from the DIR register, or with a hardware or software reset.

## Bit 6 DMA REQUEST

Active high status of the DMA request pending.

## Bit 7 INTERRUPT PENDING

Active high bit indicating the state of the Floppy Disk Interrupt.

### 11.1.2 STATUS REGISTER B (SRB)

#### Address 3F1 READ ONLY

This register is read-only and monitors the state of several disk interface pins in PS/2 and Model 30 modes. The SRB can be accessed at any time when in PS/2 mode. In the PC/AT mode the data bus pins D0 – D7 are held in a high impedance state for a read of address 3F1.

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## 11.1.2.1 PS/2 Mode

	7	6	5	4	3	2	1	0
	1	1	DRIVE SELO	WDATA TOGGLE	RDATA TOGGLE	WGATE	MOT EN1	MOT EN0
RESET COND.	1	1	0	0	0	0	0	0

### Bit 0 MOTOR ENABLE 0

Active high status of the MTR0 disk interface output pin. This bit is low after a hardware reset and unaffected by a software reset.

### Bit 1 MOTOR ENABLE 1

Active high status of the MTR1 disk interface output pin. This bit is low after a hardware reset and unaffected by a software reset. **Note:** This function is not supported.

### Bit 2 WRITE GATE

Active high status of the WGATE disk interface output.

### Bit 3 READ DATA TOGGLE

Every inactive edge of the RDATA input causes this bit to change state.

### Bit 4 WRITE DATA TOGGLE

Every inactive edge of the WDATA input causes this bit to change state.

### Bit 5 DRIVE SELECT 0

Reflects the status of the Drive Select 0 bit of the DOR (address 3F2 bit 0). This bit is cleared after a hardware reset and it is unaffected by a software reset.

### Bit 6 RESERVED

Always read as a logic "1".

### Bit 7 RESERVED

Always read as a logic "1".

## 11.1.2.2 PS/2 Model 30 Mode

	7	6	5	4	3	2	1	0
	nDRV2	DS1#	DS0#	WDATA F/F	RDATA F/F	WGATE F/F	nDS3	nDS2
RESET COND.	N/A	1	1	0	0	0	1	1

### Bit 0 nDRIVE SELECT 2

The DS2 disk interface is not supported.

### Bit 1 nDRIVE SELECT 3

The DS3 disk interface is not supported.

### Bit 2 WRITE GATE

Active high status of the latched WGATE output signal. This bit is latched by the active going edge of WGATE and is cleared by the read of the DIR register.

### Bit 3 READ DATA

Active high status of the latched RDATA output signal. This bit is latched by the inactive going edge of RDATA and is cleared by the read of the DIR register.

### Bit 4 WRITE DATA

Active high status of the latched WDATA output signal. This bit is latched by the inactive going edge of WDATA and is cleared by the read of the DIR register. This bit is not gated with WGATE.

## Bit 5 nDRIVE SELECT 0

Active low status of the DS0 disk interface output.

## Bit 6 nDRIVE SELECT 1

Active low status of the DS1 disk interface output. **Note:** This function is not supported.

## Bit 7 nDRV2

Active low status of the DRV2 disk interface input. **Note:** This function is not supported.

### 11.1.3 DIGITAL OUTPUT REGISTER (DOR)

#### Address 3F2 READ/WRITE

The DOR controls the drive select and motor enables of the disk interface outputs. It also contains the enable for the DMA logic and a software reset bit. The contents of the DOR are unaffected by a software reset. The DOR can be written to at any time.

	7	6	5	4	3	2	1	0
	MOT EN3	MOT EN2	MOT EN1	MOT EN0	DMAEN	nRESET	DRIVE SEL1	DRIVE SEL0
RESET COND.	0	0	0	0	0	0	0	0

#### Bit 0 and 1 DRIVE SELECT

These two bits are binary encoded for the drive selects, thereby allowing only one drive to be selected at one time. **Note:** Only one drive is supported.

#### Bit 2 nRESET

A logic "0" written to this bit resets the Floppy disk controller. This reset will remain active until a logic "1" is written to this bit. This software reset does not affect the DSR and CCR registers, nor does it affect the other bits of the DOR register. The minimum reset duration required is 100ns, toggling this bit by consecutive writes to this register is a valid method of issuing a software reset.

#### Bit 3 DMAEN

PC/AT and Model 30 Mode:

Writing this bit to logic "1" will enable the DMA and interrupt functions. This bit being a logic "0" will disable the DMA and interrupt functions. This bit is a logic "0" after a reset and in these modes.

PS/2 Mode: In this mode the DMA and interrupt functions are always enabled. During a reset, this bit will be cleared to a logic "0".

#### Bit 4 MOTOR ENABLE 0

This bit controls the MTR0 disk interface output. A logic "1" in this bit will cause the output pin to go active.

#### Bit 5 MOTOR ENABLE 1

This bit controls the MTR1 disk interface output. A logic "1" in this bit will cause the output pin to go active. **Note:** MTR1 output is not supported.

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**Note:** In the following tables, DS1# and MTR1# are not supported. They are included for reference to previous designs.

Drive	DOR Value
0	1CH
1	2DH

**TABLE 11-2: INTERNAL 2 DRIVE DECODE – NORMAL**

Digital Output Register				Drive Select Outputs (Active Low)		Motor on Outputs (Active Low)	
Bit 5	Bit 4	Bit1	Bit 0	DS1#	DS0#	MTR1#	MTR0#
X	1	0	0	1	0	nBIT 5	nBIT 4
1	X	0	1	0	1	nBIT 5	nBIT 4
0	0	X	X	1	1	nBIT 5	nBIT 4

**TABLE 11-3: INTERNAL 2 DRIVE DECODE – DRIVES 0 AND 1 SWAPPED**

Digital Output Register				Drive Select Outputs (Active Low)		Motor on Outputs (Active Low)	
Bit 5	Bit 4	Bit1	Bit 0	DS1#	DS0#	MTR1#	MTR0#
X	1	0	0	0	1	nBIT 4	nBIT 5
1	X	0	1	1	0	nBIT 4	nBIT 5
0	0	X	X	1	1	nBIT 4	nBIT 5

#### Bit 6 MOTOR ENABLE 2

The MTR2 disk interface output is not supported in the SCH5627P.

#### Bit 7 MOTOR ENABLE 3

The MTR3 disk interface output is not supported in the SCH5627P.

### 11.1.4 TAPE DRIVE REGISTER (TDR)

#### Address 3F3 READ/WRITE

The Tape Drive Register (TDR) is included for 82077 software compatibility and allows the user to assign tape support to a particular drive during initialization. Any future references to that drive automatically invokes tape support. The TDR Tape Select bits TDR.[1:0] determine the tape drive number. [Table 11-4](#) illustrates the Tape Select Bit encoding. Note that drive 0 is the boot device and cannot be assigned tape support. The remaining Tape Drive Register bits TDR.[7:2] are tristated when read. The TDR is unaffected by a software reset.

**TABLE 11-4: TAPE SELECT BITS**

Tape SEL1 (TDR.1)	Tape SEL0 (TDR.0)	Drive Selected
0	0	None
0	1	1
1	0	2
1	1	3

#### 11.1.4.1 Normal Floppy Mode

Normal mode. Register 3F3 contains only bits 0 and 1. When this register is read, bits 2 – 7 are '0'.

	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
REG 3F3	0	0	0	0	0	0	tape sel1	tape sel0

## 11.1.4.2 Enhanced Floppy Mode 2 (OS2)

Register 3F3 for Enhanced Floppy Mode 2 operation.

	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
REG 3F3	Reserved	Reserved	Drive Type ID		Floppy Boot Drive		tape sel1	tape sel0

### Bit 3:2 Floppy Boot Drive

Read only. Always returns 0.

### Bit 5:4 Drive Type ID

**TABLE 11-5: DRIVE TYPE ID**

Digital Output Register		Register 3F3 – Drive Type ID	
Bit 1	Bit 0	Bit 5	Bit 4
0	0	L0-CRF2 – B1	L0-CRF2 – B0
0	1	L0-CRF2 – B3	L0-CRF2 – B2
1	0	L0-CRF2 – B5	L0-CRF2 – B4
1	1	L0-CRF2 – B7	L0-CRF2 – B6

**Note:** L0-CRF2-Bx = Logical Device 0, Configuration Register F2, Bit x.

## 11.1.5 DATA RATE SELECT REGISTER (DSR)

### Address 3F4 WRITE ONLY

This register is write only. It is used to program the data rate, amount of write precompensation, power down status, and software reset. The data rate is programmed using the Configuration Control Register (CCR) not the DSR, for PC/AT and PS/2 Model 30.

	7	6	5	4	3	2	1	0
	S/W RESET	POWER DOWN	0	PRE- COMP2	PRE- COMP1	PRE- COMP0	DRATE SEL1	DRATE SEL0
RESET COND.	0	0	0	0	0	0	1	0

This register is write only. It is used to program the data rate, amount of write precompensation, power down status, and software reset. The data rate is programmed using the Configuration Control Register (CCR) not the DSR, for PC/AT and PS/2 Model 30.

Other applications can set the data rate in the DSR. The data rate of the floppy controller is the most recent write of either the DSR or CCR. The DSR is unaffected by a software reset. A hardware reset will set the DSR to 02H, which corresponds to the default precompensation setting and 250 Kbps.

### Bit 0 and 1 DATA RATE SELECT

These bits control the data rate of the floppy controller. See [Table 11-7](#) for the settings corresponding to the individual data rates. The data rate select bits are unaffected by a software reset, and are set to 250 Kbps after a hardware reset.

### Bit 2 through 4 PRECOMPENSATION SELECT

These three bits select the value of write precompensation that will be applied to the WDATA output signal. [Table 11-6](#) shows the precompensation values for the combination of these bits settings. Track 0 is the default starting track number to start precompensation. This starting track number can be changed by the configure command.

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**TABLE 11-6: PRECOMPENSATION DELAYS**

Precomp 432	Precompensation Delay (nsec)	
	<2Mbps	2Mbps
111	0.00	0
001	41.67	20.8
010	83.34	41.7
011	125.00	62.5
100	166.67	83.3
101	208.33	104.2
110	250.00	125
000	Default	Default

Default: See [Table 11-9 on page 105](#).

**Bit 5 UNDEFINED**

Should be written as a logic “0”.

**Bit 6 LOW POWER**

A logic “1” written to this bit will put the floppy controller into manual low power mode. The floppy controller clock and data separator circuits will be turned off. The controller will come out of manual low power mode after a software reset or access to the Data Register or Main Status Register.

**Bit 7 SOFTWARE RESET**

This active high bit has the same function as the DOR RESET (DOR bit 2) except that this bit is self clearing.

**Note:** The DSR is Shadowed in the Floppy Data Rate Select Shadow Register, located at the offset 0x1F in the runtime register block.

**TABLE 11-7: DATA RATES**

Drive Rate DRT0	Data Rate SEL1 SEL0		Data Rate MFM FM		DENSEL	DRATE (11-1)	
	SEL1	SEL0	MFM	FM		1	0
0	1	1	1Meg	---	1	1	1
0	0	0	500	250	1	0	0
0	0	1	300	150	0	0	1
0	1	0	250	125	0	1	0
1	1	1	1Meg	---	1	1	1
1	0	0	500	250	1	0	0
1	0	1	500	250	0	0	1
1	1	0	250	125	0	1	0

Drive Rate Table (Recommended) 00 = 360K, 1.2M, 720K, 1.44M and 2.88M Vertical Format

01 = 3-Mode Drive

10 = 2 Meg Tape

**Note 11-1** The DRATE and DENSEL values are mapped onto the DRV DEN pin.

**TABLE 11-8: DRVDEN MAPPING**

DT1	DT0	DRVDEN0 (11-1)	Drive Type
0	0	DENSEL	4/2/1 MB 3.5" 2/1 MB 5.25" FDDS 2/1.6/1 MB 3.5" (3-MODE)
1	0	DRATE1	
0	1	nDENSEL	PS/2
1	1	DRATE0	



**TABLE 11-9: DEFAULT PRECOMPENSATION DELAYS**

Data Rate	Precompensation Delay
2 Mbps	20.8 ns
1 Mbps	41.67 ns
500 Kbps	125 ns
300 Kbps	125 ns
250 Kbps	125 ns

## 11.1.6 MAIN STATUS REGISTER

### Address 3F4 READ ONLY

The Main Status Register is a read-only register and indicates the status of the disk controller. The Main Status Register can be read at any time. The MSR indicates when the disk controller is ready to receive data via the Data Register. It should be read before each byte transferring to or from the data register except in DMA mode. No delay is required when reading the MSR after a data transfer.

7	6	5	4	3	2	1	0
RQM	DIO	NON DMA	CMD BUSY	Reserved	Reserved	DRV1 BUSY	DRV0 BUSY

#### Bit 0 – 1 DRV x BUSY

These bits are set to 1s when a drive is in the seek portion of a command, including implied and overlapped seeks and recalibrates.

#### Bit 4 COMMAND BUSY

This bit is set to a 1 when a command is in progress. This bit will go active after the command byte has been accepted and goes inactive at the end of the results phase. If there is no result phase (Seek, Recalibrate commands), this bit is returned to a 0 after the last command byte.

#### Bit 5 NON-DMA

Reserved, read '0'. This part does not support non-DMA mode.

#### Bit 6 DIO

Indicates the direction of a data transfer once a RQM is set. A 1 indicates a read and a 0 indicates a write is required.

#### Bit 7 RQM

Indicates that the host can transfer data if set to a 1. No access is permitted if set to a 0.

## 11.1.7 DATA REGISTER (FIFO)

### Address 3F5 READ/WRITE

All command parameter information, disk data and result status are transferred between the host processor and the floppy disk controller through the Data Register.

Data transfers are governed by the RQM and DIO bits in the Main Status Register.

The Data Register defaults to FIFO disabled mode after any form of reset. This maintains PC/AT hardware compatibility. The default values can be changed through the Configure command (enable full FIFO operation with threshold control). The advantage of the FIFO is that it allows the system a larger DMA latency without causing a disk error. [Table 11-10](#) gives several examples of the delays with a FIFO.

The data is based upon the following formula:

$$\text{Threshold \# } x \left| \frac{1}{(\text{DATA RATE})} \right| x 8 \left| - 1.5 \mu\text{s} = \text{DELAY} \right.$$

At the start of a command, the FIFO action is always disabled and command parameters must be sent based upon the RQM and DIO bit settings. As the command execution phase is entered, the FIFO is cleared of any data to ensure that invalid data is not transferred.

An overrun or underrun will terminate the current command and the transfer of data. Disk writes will complete the current sector by generating a 00 pattern and valid CRC. Reads require the host to remove the remaining data so that the result phase may be entered.

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**TABLE 11-10: FIFO SERVICE DELAY**

FIFO THRESHOLD EXAMPLES	MAXIMUM DELAY TO SERVICING AT 2 MBPS DATA RATE
1 byte 2 bytes 8 bytes 15 bytes	1 x 4 $\mu$ s - 1.5 $\mu$ s = 2.5 $\mu$ s 2 x 4 $\mu$ s - 1.5 $\mu$ s = 6.5 $\mu$ s 8 x 4 $\mu$ s - 1.5 $\mu$ s = 30.5 $\mu$ s 15 x 4 $\mu$ s - 1.5 $\mu$ s = 58.5 $\mu$ s
FIFO THRESHOLD EXAMPLES	MAXIMUM DELAY TO SERVICING AT 1 MBPS DATA RATE
1 byte 2 bytes 8 bytes 15 bytes	1 x 8 $\mu$ s - 1.5 $\mu$ s = 6.5 $\mu$ s 2 x 8 $\mu$ s - 1.5 $\mu$ s = 14.5 $\mu$ s 8 x 8 $\mu$ s - 1.5 $\mu$ s = 62.5 $\mu$ s 15 x 8 $\mu$ s - 1.5 $\mu$ s = 118.5 $\mu$ s
FIFO THRESHOLD EXAMPLES	MAXIMUM DELAY TO SERVICING AT 500 Kbps DATA RATE
1 byte 2 bytes 8 bytes 15 bytes	1 x 16 $\mu$ s - 1.5 $\mu$ s = 14.5 $\mu$ s 2 x 16 $\mu$ s - 1.5 $\mu$ s = 30.5 $\mu$ s 8 x 16 $\mu$ s - 1.5 $\mu$ s = 126.5 $\mu$ s 15 x 16 $\mu$ s - 1.5 $\mu$ s = 238.5 $\mu$ s

## 11.1.8 DIGITAL INPUT REGISTER (DIR)

### Address 3F7 READ ONLY

This register is read-only in all modes.

#### 11.1.8.1 PC-AT Mode

	7	6	5	4	3	2	1	0
	DSK CHG	0	0	0	0	0	0	0
RESET COND.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

#### Bit 0 – 6 UNDEFINED

The data bus outputs D0 – 6 are read as '0'.

#### Bit 7 DSKCHG

This bit monitors the pin of the same name and reflects the opposite value seen on the disk cable or the value programmed in the Force Disk Change Register (see the Runtime Register at offset 0x1E).

#### 11.1.8.2 PS/2 Mode

	7	6	5	4	3	2	1	0
	DSK CHG	1	1	1	1	DRATE SEL1	DRATE SEL0	nHIGH DENS
RESET COND.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1

#### Bit 0 nHIGH DENS

This bit is low whenever the 500 Kbps or 1 Mbps data rates are selected, and high when 250 Kbps and 300 Kbps are selected.

#### Bits 1 – 2 DATA RATE SELECT

These bits control the data rate of the floppy controller. See [Table 11-7 on page 104](#) for the settings corresponding to the individual data rates. The data rate select bits are unaffected by a software reset, and are set to 250 Kbps after a hardware reset.

#### Bits 3 – 6 UNDEFINED

Always read as a logic "1"

## Bit 7 DSKCHG

This bit monitors the pin of the same name and reflects the opposite value seen on the disk cable or the value programmed in the Force Disk Change Register (see Runtime Register at offset 0x1E).

### 11.1.8.3 Model 30 Mode

	7	6	5	4	3	2	1	0
	DSK CHG	0	0	0	DMAEN	NOPRE C	DRATE SEL1	DRATE SEL0
RESET COND.	N/A	0	0	0	0	0	1	0

## Bits 0 – 1 DATA RATE SELECT

These bits control the data rate of the floppy controller. See [Table 11-7](#) for the settings corresponding to the individual data rates. The data rate select bits are unaffected by a software reset, and are set to 250 Kbps after a hardware reset.

## Bit 2 NOPREC

This bit reflects the value of NOPREC bit set in the CCR register.

## Bit 3 DMAEN

This bit reflects the value of DMAEN bit set in the DOR register bit 3.

## Bits 4 – 6 UNDEFINED

Always read as a logic “0”

## Bit 7 DSKCHG

This bit monitors the pin of the same name and reflects the opposite value seen on the disk cable or the value programmed in the Force Disk Change Register (see Runtime Register at offset 0x1E).

## 11.1.9 CONFIGURATION CONTROL REGISTER (CCR)

### Address 3F7 WRITE ONLY

#### 11.1.9.1 PC/AT and PS/2 Modes

	7	6	5	4	3	2	1	0
	0	0	0	0	0	0	DRATE SEL1	DRATE SEL0
RESET COND.	N/A	N/A	N/A	N/A	N/A	N/A	1	0

## Bit 0 and 1 DATA RATE SELECT 0 and 1

These bits determine the data rate of the floppy controller. See [Table 11-7 on page 104](#) for the appropriate values.

## Bit 2 – 7 RESERVED

Should be set to a logical “0”

#### 11.1.9.2 PS/2 Model 30 Mode

	7	6	5	4	3	2	1	0
	0	0	0	0	0	NOPREC	DRATE SEL1	DRATE SEL0
RESET COND.	N/A	N/A	N/A	N/A	N/A	N/A	1	0

## Bit 0 and 1 DATA RATE SELECT 0 and 1

These bits determine the data rate of the floppy controller. See [Table 11-7 on page 104](#) for the appropriate values.

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## Bit 2 NO PRECOMPENSATION

This bit can be set by software, but it has no functionality. It can be read by bit 2 of the DSR when in Model 30 register mode. Unaffected by software reset.

## Bit 3 – 7 RESERVED

Should be set to a logical “0”

Table 11-8 on page 104 shows the state of the DENSEL pin. The DENSEL pin is set high after a hardware reset and is unaffected by the DOR and the DSR resets.

## 11.2 Status Register Encoding

During the Result Phase of certain commands, the Data Register contains data bytes that give the status of the command just executed.

**TABLE 11-11: STATUS REGISTER 0**

Bit No.	Symbol	Name	Description
7,6	IC	Interrupt Code	00 - Normal termination of command. The specified command was properly executed and completed without error. 01 - Abnormal termination of command. Command execution was started, but was not successfully completed. 10 - Invalid command. The requested command could not be executed. 11 - Abnormal termination caused by Polling.
5	SE	Seek End	The FDC completed a Seek, Relative Seek or Recalibrate command (used during a Sense Interrupt Command).
4	EC	Equipment Check	The TRK0 pin failed to become a “1” after: 1. 80 step pulses in the Recalibrate command. 2. The Relative Seek command caused the FDC to step outward beyond Track 0.
3			Unused. This bit is always “0”.
2	H	Head Address	The current head address.
1,0	DS1,0	Drive Select	The current selected drive.

**TABLE 11-12: STATUS REGISTER 1**

Bit No.	Symbol	Name	Description
7	EN	End of Cylinder	The FDC tried to access a sector beyond the final sector of the track (255D). Will be set if TC is not issued after Read or Write Data command.
6			Unused. This bit is always “0”.
5	DE	Data Error	The FDC detected a CRC error in either the ID field or the data field of a sector.
4	OR	Overrun/ Underrun	Becomes set if the FDC does not receive CPU or DMA service within the required time interval, resulting in data overrun or underrun.
3			Unused. This bit is always “0”.
2	ND	No Data	Any one of the following: 1. Read Data, Read Deleted Data command - the FDC did not find the specified sector. 2. Read ID command - the FDC cannot read the ID field without an error. 3. Read A Track command - the FDC cannot find the proper sector sequence.
1	NW	Not Writable	WP pin became a “1” while the FDC is executing a Write Data, Write Deleted Data, or Format A Track command.

**TABLE 11-12: STATUS REGISTER 1 (CONTINUED)**

Bit No.	Symbol	Name	Description
0	MA	Missing Address Mark	Any one of the following: 1. The FDC did not detect an ID address mark at the specified track after encountering the index pulse from the INDEX# pin twice. 2. The FDC cannot detect a data address mark or a deleted data address mark on the specified track.

**TABLE 11-13: STATUS REGISTER 2**

Bit No.	Symbol	Name	Description
7			Unused. This bit is always "0".
6	CM	Control Mark	Any one of the following: Read Data command - the FDC encountered a deleted data address mark. Read Deleted Data command - the FDC encountered a data address mark.
5	DD	Data Error in Data Field	The FDC detected a CRC error in the data field.
4	WC	Wrong Cylinder	The track address from the sector ID field is different from the track address maintained inside the FDC.
3			Unused. This bit is always "0".
2			Unused. This bit is always "0".
1	BC	Bad Cylinder	The track address from the sector ID field is different from the track address maintained inside the FDC and is equal to FF hex, which indicates a bad track with a hard error according to the IBM soft-sectored format.
0	MD	Missing Data Address Mark	The FDC cannot detect a data address mark or a deleted data address mark.

**TABLE 11-14: STATUS REGISTER 3**

Bit No.	Symbol	Name	Description
7			Unused. This bit is always "0".
6	WP	Write Protected	Indicates the status of the WRTPRT pin.
5			Unused. This bit is always "1".
4	T0	Track 0	Indicates the status of the TRK0 pin.
3			Unused. This bit is always "1".
2	HD	Head Address	Indicates the status of the HDSEL pin.
1,0	DS1,0	Drive Select	Indicates the status of the DS1, DS0 pins. <b>Note:</b> DS1 is not supported.

## 11.3 Reset

There are three sources of system reset on the FDC: the PCI RESET# pin, a reset generated via a bit in the DOR, and a reset generated via a bit in the DSR. At power on, a Power On Reset initializes the FDC. All resets take the FDC out of the power down state.

All operations are terminated upon a PCI RESET#, and the FDC enters an idle state. A reset while a disk write is in progress will corrupt the data and CRC.

On exiting the reset state, various internal registers are cleared, including the Configure command information, and the FDC waits for a new command. Drive polling will start unless disabled by a new Configure command.

### PCI RESET# Pin (Hardware Reset)

The PCI RESET# pin is a global reset and clears all registers except those programmed by the Specify command. The DOR reset bit is enabled and must be cleared by the host to exit the reset state.

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## DOR Reset vs. DSR Reset (Software Reset)

These two resets are functionally the same. Both will reset the FDC core, which affects drive status information and the FIFO circuits. The DSR reset clears itself automatically while the DOR reset requires the host to manually clear it. DOR reset has precedence over the DSR reset. The DOR reset is set automatically upon a pin reset. The user must manually clear this reset bit in the DOR to exit the reset state.

## 11.4 Modes of Operation

The FDC has three modes of operation, PC/AT mode, PS/2 mode and Model 30 mode. These are determined by the state of the Interface Mode bits in LD0-CRF0[3,2].

### PC/AT Mode

The PC/AT register set is enabled, the DMA enable bit of the DOR becomes valid (controls the interrupt and DMA functions), and DENSEL is an active high signal.

### PS/2 Mode

This mode supports the PS/2 models 50/60/80 configuration and register set. The DMA bit of the DOR becomes a “don't care”. The DMA and interrupt functions are always enabled, and DENSEL is active low.

### Model 30 mode

This mode supports PS/2 Model 30 configuration and register set. The DMA enable bit of the DOR becomes valid (controls the interrupt and DMA functions), and DENSEL is active low.

## 11.5 DMA Transfers

DMA transfers are enabled with the Specify command and are initiated by the FDC by activating a DMA request cycle. DMA read, write and verify cycles are supported. The FDC supports two DMA transfer modes: Single Transfer and Burst Transfer. Burst mode is enabled via Logical Device 0-CRF0-Bit[1] (LD0-CRF0[1]).

## 11.6 Controller Phases

For simplicity, command handling in the FDC can be divided into three phases: Command, Execution, and Result. Each phase is described in the following sections.

### 11.6.1 COMMAND PHASE

After a reset, the FDC enters the command phase and is ready to accept a command from the host. For each of the commands, a defined set of command code bytes and parameter bytes has to be written to the FDC before the command phase is complete. (Please refer to [Table 11-15 on page 111](#) for the command set descriptions). These bytes of data must be transferred in the order prescribed.

Before writing to the FDC, the host must examine the RQM and DIO bits of the Main Status Register. RQM and DIO must be equal to “1” and “0” respectively before command bytes may be written. RQM is set false by the FDC after each write cycle until the received byte is processed. The FDC asserts RQM again to request each parameter byte of the command unless an illegal command condition is detected. After the last parameter byte is received, RQM remains “0” and the FDC automatically enters the next phase as defined by the command definition.

The FIFO is disabled during the command phase to provide for the proper handling of the “Invalid Command” condition.

### 11.6.2 EXECUTION PHASE

All data transfers to or from the FDC occur during the execution phase, which can proceed in DMA mode as indicated in the Specify command.

After a reset, the FIFO is disabled. Each data byte is transferred by a read/write or DMA cycle depending on the DMA mode. The Configure command can enable the FIFO and set the FIFO threshold value.

The following paragraphs detail the operation of the FIFO flow control. In these descriptions, <threshold> is defined as the number of bytes available to the FDC when service is requested from the host and ranges from 1 to 16. The parameter FIFOTHR, which the user programs, is one less and ranges from 0 to 15.

A low threshold value (i.e. 2) results in longer periods of time between service requests, but requires faster servicing of the request for both read and write cases. The host reads (writes) from (to) the FIFO until empty (full), then the transfer request goes inactive. The host must be very responsive to the service request. This is the desired case for use with a “fast” system.

A high value of threshold (i.e. 12) is used with a “sluggish” system by affording a long latency period after a service request, but results in more frequent service requests.

## Non-DMA Mode – Transfers from the FIFO to the Host

This part does not support non-DMA mode.

## Non-DMA Mode – Transfers from the Host to the FIFO

This part does not support non-DMA mode.

## DMA Mode – Transfers from the FIFO to the Host

The FDC generates a DMA request cycle when the FIFO contains (16 - <threshold>) bytes, or the last byte of a full sector transfer has been placed in the FIFO. The DMA controller must respond to the request by reading data from the FIFO. The FDC will deactivate the DMA request when the FIFO becomes empty by generating the proper sync for the data transfer.

## DMA Mode – Transfers from the Host to the FIFO.

The FDC generates a DMA request cycle when entering the execution phase of the data transfer commands. The DMA controller must respond by placing data in the FIFO. The DMA request remains active until the FIFO becomes full. The DMA request cycle is reasserted when the FIFO has <threshold> bytes remaining in the FIFO. The FDC will terminate the DMA cycle after a TC, indicating that no more data is required.

## Data Transfer Termination

The FDC supports terminal count explicitly through the TC pin and implicitly through the underrun/overflow and end-of-track (EOT) functions. For full sector transfers, the EOT parameter can define the last sector to be transferred in a single or multi-sector transfer.

If the last sector to be transferred is a partial sector, the host can stop transferring the data in mid-sector, and the FDC will continue to complete the sector as if a TC cycle was received. The only difference between these implicit functions and TC cycle is that they return “abnormal termination” result status. Such status indications can be ignored if they were expected.

Note that when the host is sending data to the FIFO of the FDC, the internal sector count will be complete when the FDC reads the last byte from its side of the FIFO. There may be a delay in the removal of the transfer request signal of up to the time taken for the FDC to read the last 16 bytes from the FIFO. The host must tolerate this delay.

### 11.6.3 RESULT PHASE

The generation of the interrupt determines the beginning of the result phase. For each of the commands, a defined set of result bytes has to be read from the FDC before the result phase is complete. These bytes of data must be read out for another command to start.

RQM and DIO must both equal “1” before the result bytes may be read. After all the result bytes have been read, the RQM and DIO bits switch to “1” and “0” respectively, and the CB bit is cleared, indicating that the FDC is ready to accept the next command.

## 11.7 Command Set/Descriptions

Commands can be written whenever the FDC is in the command phase. Each command has a unique set of needed parameters and status results. The FDC checks to see that the first byte is a valid command and, if valid, proceeds with the command. If it is invalid, an interrupt is issued. The user sends a Sense Interrupt Status command which returns an invalid command error. Refer to [Table 11-15](#) for explanations of the various symbols used. [Table 11-16](#) lists the required parameters and the results associated with each command that the FDC is capable of performing.

**TABLE 11-15: DESCRIPTION OF COMMAND SYMBOLS**

Symbol	Name	Description
C	Cylinder Address	The currently selected address; 0 to 255.
D	Data Pattern	The pattern to be written in each sector data field during formatting.
D0, D1	Drive Select 0-1	Designates which drives are perpendicular drives on the Perpendicular Mode Command. A “1” indicates a perpendicular drive.
DIR	Direction Control	If this bit is 0, then the head will step out from the spindle during a relative seek. If set to a 1, the head will step in toward the spindle.

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**TABLE 11-15: DESCRIPTION OF COMMAND SYMBOLS (CONTINUED)**

Symbol	Name	Description									
DS0, DS1	Disk Drive Select	<table border="1"> <thead> <tr> <th>DS1</th> <th>DS0</th> <th>DRIVE</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Drive 0</td> </tr> <tr> <td>0</td> <td>1</td> <td>Drive 1</td> </tr> </tbody> </table> <p><b>Note:</b> Drive 1 is not supported</p>	DS1	DS0	DRIVE	0	0	Drive 0	0	1	Drive 1
DS1	DS0	DRIVE									
0	0	Drive 0									
0	1	Drive 1									
DTL	Special Sector Size	By setting N to zero (00), DTL may be used to control the number of bytes transferred in disk read/write commands. The sector size (N = 0) is set to 128. If the actual sector (on the diskette) is larger than DTL, the remainder of the actual sector is read but is not passed to the host during read commands; during write commands, the remainder of the actual sector is written with all zero bytes. The CRC check code is calculated with the actual sector. When N is not zero, DTL has no meaning and should be set to FF HEX.									
EC	Enable Count	When this bit is "1" the "DTL" parameter of the Verify command becomes SC (number of sectors per track).									
EFIFO	Enable FIFO	This active low bit when a 0, enables the FIFO. A "1" disables the FIFO (default).									
EIS	Enable Implied Seek	When set, a seek operation will be performed before executing any read or write command that requires the C parameter in the command phase. A "0" disables the implied seek.									
EOT	End of Track	The final sector number of the current track.									
GAP		Alters Gap 2 length when using Perpendicular Mode.									
GPL	Gap Length	The Gap 3 size. (Gap 3 is the space between sectors excluding the VCO synchronization field).									
H/HDS	Head Address	Selected head: 0 or 1 (disk side 0 or 1) as encoded in the sector ID field.									
HLT	Head Load Time	The time interval that FDC waits after loading the head and before initializing a read or write operation. Refer to the Specify command for actual delays.									
HUT	Head Unload Time	The time interval from the end of the execution phase (of a read or write command) until the head is unloaded. Refer to the Specify command for actual delays.									
LOCK		Lock defines whether EFIFO, FIFOTHR, and PRETRK parameters of the CONFIGURE COMMAND can be reset to their default values by a "software Reset". (A reset caused by writing to the appropriate bits of either the DSR or DOR)									
MFM	MFM/FM Mode Selector	A one selects the double density (MFM) mode. A zero selects single density (FM) mode.									
MT	Multi-Track Selector	When set, this flag selects the multi-track operating mode. In this mode, the FDC treats a complete cylinder under head 0 and 1 as a single track. The FDC operates as this expanded track started at the first sector under head 0 and ended at the last sector under head 1. With this flag set, a multitrack read or write operation will automatically continue to the first sector under head 1 when the FDC finishes operating on the last sector under head 0.									
N	Sector Size Code	<p>This specifies the number of bytes in a sector. If this parameter is "00", then the sector size is 128 bytes. The number of bytes transferred is determined by the DTL parameter. Otherwise the sector size is (2 raised to the "Nth" power) times 128. All values up to "07" hex are allowable. "07" would equal a sector size of 16K. It is the user's responsibility to not select combinations that are not possible with the drive.</p> <p>N SECTOR SIZE            00 128 Bytes            01 256 Bytes            02 512 Bytes            03 1024 Bytes            ...            07 16K Bytes ...</p>									
NCN	New Cylinder Number	The desired cylinder number.									
ND	Non-DMA Mode Flag	Write '0'. This part does not support non-DMA mode.									



**TABLE 11-15: DESCRIPTION OF COMMAND SYMBOLS (CONTINUED)**

Symbol	Name	Description
OW	Overwrite	The bits D0-D3 of the Perpendicular Mode Command can only be modified if OW is set to 1. OW is defined in the Lock command.
PCN	Present Cylinder Number	The current position of the head at the completion of Sense Interrupt Status command.
POLL	Polling Disable	When set, the internal polling routine is disabled. When clear, polling is enabled.
PRETRK	Precompensation Start Track Number	Programmable from track 00 to FFH.
R	Sector Address	The sector number to be read or written. In multi-sector transfers, this parameter specifies the sector number of the first sector to be read or written.
RCN	Relative Cylinder Number	Relative cylinder offset from present cylinder as used by the Relative Seek command.
SC	Number of Sectors Per Track	The number of sectors per track to be initialized by the Format command. The number of sectors per track to be verified during a Verify command when EC is set.
SK	Skip Flag	When set to 1, sectors containing a deleted data address mark will automatically be skipped during the execution of Read Data. If Read Deleted is executed, only sectors with a deleted address mark will be accessed. When set to "0", the sector is read or written the same as the read and write commands.
SRT	Step Rate Interval	The time interval between step pulses issued by the FDC. Programmable from 0.5 to 8 milliseconds in increments of 0.5 ms at the 1 Mbit data rate. Refer to the SPECIFY command for actual delays.
ST0 ST1 ST2 ST3	Status 0 Status 1 Status 2 Status 3	Registers within the FDC which store status information after a command has been executed. This status information is available to the host during the result phase after command execution.
WGATE	Write Gate	Alters timing of WE to allow for pre-erase loads in perpendicular drives.

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## 11.8 Instruction Set

**TABLE 11-16: INSTRUCTION SET**

READ DATA										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	MT	MFM	SK	0	0	1	1	0	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	C								Sector ID information prior to Command execution.
	W	H								
	W	R								
	W	N								
	W	EOT								
	W	GPL								
	W	DTL								
Execution										Data transfer between the FDD and system.
Result	R	ST0								Status information after Command execution.
	R	ST1								
	R	ST2								
	R	C								Sector ID information after Command execution.
	R	H								
	R	R								
	R	N								

WRITE DATA										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	MT	MFM	0	0	0	1	0	1	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	C								Sector ID information prior to Command execution.
	W	H								
	W	R								
	W	N								
	W	EOT								
	W	GPL								
	W	DTL								
Execution										Data transfer between the FDD and system.
Result	R	ST0								Status information after Command execution.
	R	ST1								
	R	ST2								
	R	C								Sector ID information after Command execution.
	R	H								
	R	R								
	R	N								

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WRITE DELETED DATA										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	MT	MFM	0	0	1	0	0	1	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	C								Sector ID information prior to Command execution.
	W	H								
	W	R								
	W	N								
	W	EOT								
	W	GPL								
	W	DTL								
Execution										Data transfer between the FDD and system.
Result	R	ST0								Status information after Command execution.
	R	ST1								
	R	ST2								
	R	C								Sector ID information after Command execution.
	R	H								
	R	R								
	R	N								

READ A TRACK										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	MFM	0	0	0	0	1	0	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	C								Sector ID information prior to Command execution.
	W	H								
	W	R								
	W	N								
	W	EOT								
	W	GPL								
	W	DTL								
Execution										Data transfer between the FDD and system. FDC reads all of cylinders' contents from index hole to EOT.
Result	R	ST0								Status information after Command execution.
	R	ST1								
	R	ST2								
	R	C								Sector ID information after Command execution.
	R	H								
	R	R								
	R	N								

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VERIFY										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	MT	MFM	SK	1	0	1	1	0	Command Codes
	W	EC	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	C								Sector ID information prior to Command execution.
	W	H								
	W	R								
	W	N								
	W	EOT								
	W	GPL								
	W	DTL/SC								
Execution										No data transfer takes place.
Result	R	ST0								Status information after Command execution.
	R	ST1								
	R	ST2								
	R	C								Sector ID information after Command execution.
	R	H								
	R	R								
	R	N								

VERSION										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	1	0	0	0	0	Command Code
Result	R	1	0	0	1	0	0	0	0	Enhanced Controller

FORMAT A TRACK										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	MFM	0	0	1	1	0	1	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	N								Bytes/Sector
	W	SC								Sectors/Cylinder
	W	GPL								Gap 3
	W	D								Filler Byte
Execution for Each Sector Repeat:	W	C								Input Sector Parameters
	W	H								
	W	R								
	W	N								
										FDC formats an entire cylinder
Result	R	ST0								Status information after Command execution
	R	ST1								
	R	ST2								
	R	Undefined								
	R	Undefined								
	R	Undefined								
	R	Undefined								

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RECALIBRATE										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	0	0	1	1	1	Command Codes
	W	0	0	0	0	0	0	DS1	DS0	Drive 1 not supported
Execution										Head retracted to Track 0 Interrupt.

SENSE INTERRUPT STATUS										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	0	1	0	0	0	Command Codes
Result	R	ST0								Status information at the end of each seek operation.
	R	PCN								

SPECIFY										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	0	0	0	1	1	Command Codes
	W	SRT				HUT				
	W	HLT							ND	

SENSE DRIVE STATUS										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	0	0	1	0	0	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
Result	R	ST3								Status information about FDD



SEEK										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	0	1	1	1	1	Command Codes
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	NCN								
Execution										Head positioned over proper cylinder on diskette.

CONFIGURE										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	1	0	0	1	1	Configure Information
	W	0	0	0	0	0	0	0	0	
	W	0	EIS	EFIFO	POLL	FIFOTHR				
Execution	W	PRETRK								

RELATIVE SEEK										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	1	DIR	0	0	1	1	1	1	
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
	W	RCN								

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DUMPREG										
PHASE	R/W	DATA BUS								REMARKS
		D7	D6	D5	D4	D3	D2	D1	D0	
Command	W	0	0	0	0	1	1	1	0	<b>Note:</b> Registers placed in FIFO
Execution										
Result	R	PCN-Drive 0								
	R	PCN-Drive 1								
	R	PCN-Drive 2								
	R	PCN-Drive 3								
	R	SRT				HUT				
	R	HLT							ND	
	R	SC/EOT								
	R	LOCK	0	D3	D2	D1	D0	GAP	WGATE	
	R	0	EIS	EFIFO	POLL	FIFOTHR				
	R	PRETRK								

READ ID										
		DATA BUS								
PHASE	R/W	D7	D6	D5	D4	D3	D2	D1	D0	REMARKS
Command	W	0	MFM	0	0	1	0	1	0	Commands
	W	0	0	0	0	0	HDS	DS1	DS0	Drive 1 not supported
Execution										The first correct ID information on the Cylinder is stored in Data Register
Result	R	ST0								Status information after Command execution.  Disk status after the Command has completed.
	R	ST1								
	R	ST2								
	R	C								
	R	H								
	R	R								
	R	N								

PERPENDICULAR MODE										
		DATA BUS								
PHASE	R/W	D7	D6	D5	D4	D3	D2	D1	D0	REMARKS
Command	W	0	0	0	1	0	0	1	0	Command Codes
		OW	0	D3	D2	D1	D0	GAP	WGATE	

INVALID CODES										
		DATA BUS								
PHASE	R/W	D7	D6	D5	D4	D3	D2	D1	D0	REMARKS
Command	W	Invalid Codes								Invalid Command Codes (NoOp – FDC goes into Standby State)
Result	R	ST0								ST0 = 80H

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LOCK										
		DATA BUS								
PHASE	R/W	D7	D6	D5	D4	D3	D2	D1	D0	REMARKS
Command	W	LOCK	0	0	1	0	1	0	0	Command Codes
Result	R	0	0	0	LOCK	0	0	0	0	

SC is returned if the last command that was issued was the Format command. EOT is returned if the last command was a Read or Write.

**Note 11-2** These bits are used internally only. They are not reflected in the Drive Select pins. It is the user's responsibility to maintain correspondence between these bits and the Drive Select pins (DOR).

## 11.9 Data Transfer Commands

All of the Read Data, Write Data and Verify type commands use the same parameter bytes and return the same results information, the only difference being the coding of bits 0-4 in the first byte.

An implied seek will be executed if the feature was enabled by the Configure command. This seek is completely transparent to the user. The Drive Busy bit for the drive will go active in the Main Status Register during the seek portion of the command. If the seek portion fails, it is reflected in the results status normally returned for a Read/Write Data command. Status Register 0 (ST0) would contain the error code and C would contain the cylinder on which the seek failed.

### 11.9.1 READ DATA

A set of nine (9) bytes is required to place the FDC in the Read Data Mode. After the Read Data command has been issued, the FDC loads the head (if it is in the unloaded state), waits the specified head settling time (defined in the Specify command), and begins reading ID Address Marks and ID fields. When the sector address read off the diskette matches with the sector address specified in the command, the FDC reads the sector's data field and transfers the data to the FIFO.

After completion of the read operation from the current sector, the sector address is incremented by one and the data from the next logical sector is read and output via the FIFO. This continuous read function is called "Multi-Sector Read Operation". Upon receipt of the TC cycle, or an implied TC (FIFO overrun/underrun), the FDC stops sending data but will continue to read data from the current sector, check the CRC bytes, and at the end of the sector, terminate the Read Data Command.

N determines the number of bytes per sector (see [Table 11-17](#)). If N is set to zero, the sector size is set to 128. The DTL value determines the number of bytes to be transferred. If DTL is less than 128, the FDC transfers the specified number of bytes to the host. For reads, it continues to read the entire 128-byte sector and checks for CRC errors. For writes, it completes the 128-byte sector by filling in zeros. If N is not set to 00 Hex, DTL should be set to FF Hex and has no impact on the number of bytes transferred.

**TABLE 11-17: SECTOR SIZES**

N	Sector Size
00	128 bytes
01	256 bytes
02	512 bytes
03	1024 bytes
...	...
07	16 Kbytes

The amount of data which can be handled with a single command to the FDC depends upon MT (multi-track) and N (number of bytes/sector).

The Multi-Track function (MT) allows the FDC to read data from both sides of the diskette. For a particular cylinder, data will be transferred starting at Sector 1, Side 0 and completing the last sector of the same track at Side 1.

If the host terminates a read or write operation in the FDC, the ID information in the result phase is dependent upon the state of the MT bit and EOT byte. Refer to [Table 11-18](#).

At the completion of the Read Data command, the head is not unloaded until after the Head Unload Time Interval (specified in the Specify command) has elapsed. If the host issues another command before the head unloads, then the head settling time may be saved between subsequent reads.

If the FDC detects a pulse on the INDEX# pin twice without finding the specified sector (meaning that the diskette's index hole passes through index detect logic in the drive twice), the FDC sets the IC code in Status Register 0 to "01" indicating abnormal termination, sets the ND bit in Status Register 1 to "1" indicating a sector not found, and terminates the Read Data Command.

After reading the ID and Data Fields in each sector, the FDC checks the CRC bytes. If a CRC error occurs in the ID or data field, the FDC sets the IC code in Status Register 0 to "01" indicating abnormal termination, sets the DE bit flag in Status Register 1 to "1", sets the DD bit in Status Register 2 to "1" if CRC is incorrect in the ID field, and terminates the Read Data Command. [Table 11-19](#) describes the effect of the SK bit on the Read Data command execution and results. Except where noted in [Table 11-19](#), the C or R value of the sector address is automatically incremented (see [Table 11-21](#) on page 126).

**TABLE 11-18: EFFECTS OF MT AND N BITS**

MT	N	Maximum Transfer Capacity	Final Sector Read from Disk
0	1	256 x 26 = 6,656	26 at side 0 or 1
1	1	256 x 52 = 13,312	26 at side 1
0	2	512 x 15 = 7,680	15 at side 0 or 1
1	2	512 x 30 = 15,360	15 at side 1
0	3	1024 x 8 = 8,192	8 at side 0 or 1
1	3	1024 x 16 = 16,384	16 at side 1

**TABLE 11-19: SKIP BIT VS. READ DATA COMMAND**

SK Bit Value	Data Address Mark Type Encountered	Results		
		Sector Read?	CM Bit of ST2 Set?	Description of Results
0	Normal Data	Yes	No	Normal termination.
0	Deleted Data	Yes	Yes	Address not incremented. Next sector not searched for. Normal termination.
1	Normal Data	Yes	No	Normal termination.
1	Deleted Data	No	Yes	Sector not read ("skipped").

## 11.9.2 READ DELETED DATA

This command is the same as the Read Data command, only it operates on sectors that contain a Deleted Data Address Mark at the beginning of a Data Field.

[Table 11-20](#) describes the effect of the SK bit on the Read Deleted Data command execution and results. Except where noted in [Table 11-20](#), the C or R value of the sector address is automatically incremented (see [Table 11-21](#)).

**TABLE 11-20: SKIP BIT VS. READ DELETED DATA COMMAND**

SK Bit Value	Data Address Mark Type Encountered	Results		
		Sector Read?	CM Bit of ST2 Set?	Description of Results
0	Normal Data	Yes	Yes	Address not incremented. Next sector not searched for.
0	Deleted Data	Yes	No	Normal termination.
1	Normal Data	No	Yes	Normal termination. Sector not read ("skipped").
1	Deleted Data	Yes	No	Normal termination.

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## 11.9.3 READ A TRACK

This command is similar to the Read Data command except that the entire data field is read continuously from each of the sectors of a track. Immediately after encountering a pulse on the INDEX# pin, the FDC starts to read all data fields on the track as continuous blocks of data without regard to logical sector numbers. If the FDC finds an error in the ID or DATA CRC check bytes, it continues to read data from the track and sets the appropriate error bits at the end of the command. The FDC compares the ID information read from each sector with the specified value in the command and sets the ND flag of Status Register 1 to a "1" if there no comparison. Multi-track or skip operations are not allowed with this command. The MT and SK bits (bits D7 and D5 of the first command byte respectively) should always be set to "0".

This command terminates when the EOT specified number of sectors has not been read. If the FDC does not find an ID Address Mark on the diskette after the second occurrence of a pulse on the INDEX# pin, then it sets the IC code in Status Register 0 to "01" (abnormal termination), sets the MA bit in Status Register 1 to "1", and terminates the command.

**TABLE 11-21: RESULT PHASE**

MT	Head	Final Sector Transferred to	ID Information at Result Phase			
			C	H	R	N
		HOST	C	H	R	N
0	0	Less than EOT	NC	NC	R + 1	NC
		Equal to EOT	C + 1	NC	01	NC
	1	Less than EOT	NC	NC	R + 1	NC
		Equal to EOT	C + 1	NC	01	NC
1	0	Less than EOT	NC	NC	R + 1	NC
		Equal to EOT	NC	LSB	01	NC
	1	Less than EOT	NC	NC	R + 1	NC
		Equal to EOT	C + 1	LSB	01	NC

NC: No Change, the same value as the one at the beginning of command execution.

LSB: Least Significant Bit, the LSB of H is complemented.

## 11.9.4 WRITE DATA

After the Write Data command has been issued, the FDC loads the head (if it is in the unloaded state), waits the specified head load time if unloaded (defined in the Specify command), and begins reading ID fields. When the sector address read from the diskette matches the sector address specified in the command, the FDC reads the data from the host via the FIFO and writes it to the sector's data field.

After writing data into the current sector, the FDC computes the CRC value and writes it into the CRC field at the end of the sector transfer. The Sector Number stored in "R" is incremented by one, and the FDC continues writing to the next data field. The FDC continues this "Multi-Sector Write Operation". Upon receipt of a terminal count signal or if a FIFO over/under run occurs while a data field is being written, then the remainder of the data field is filled with zeros. The FDC reads the ID field of each sector and checks the CRC bytes. If it detects a CRC error in one of the ID fields, it sets the IC code in Status Register 0 to "01" (abnormal termination), sets the DE bit of Status Register 1 to "1", and terminates the Write Data command.

The Write Data command operates in much the same manner as the Read Data command. The following items are the same. Please refer to the Read Data Command for details:

Transfer Capacity

EN (End of Cylinder) bit

ND (No Data) bit

Head Load, Unload Time Interval

ID information when the host terminates the command

Definition of DTL when N = 0 and when N does not = 0

## 11.9.5 WRITE DELETED DATA

This command is almost the same as the Write Data command except that a Deleted Data Address Mark is written at the beginning of the Data Field instead of the normal Data Address Mark. This command is typically used to mark a bad sector containing an error on the floppy disk.

## 11.9.6 VERIFY

The Verify command is used to verify the data stored on a disk. This command acts exactly like a Read Data command except that no data is transferred to the host. Data is read from the disk and CRC is computed and checked against the previously-stored value.

Because data is not transferred to the host, the TC cycle cannot be used to terminate this command. By setting the EC bit to "1", an implicit TC will be issued to the FDC. This implicit TC will occur when the SC value has decremented to 0 (an SC value of 0 will verify 256 sectors). This command can also be terminated by setting the EC bit to "0" and the EOT value equal to the final sector to be checked. If EC is set to "0", DTL/SC should be programmed to 0FFH. Refer to [Table 11-21 on page 126](#) and [Table 11-22 on page 127](#) for information concerning the values of MT and EC versus SC and EOT value.

### Definitions:

# Sectors Per Side = Number of formatted sectors per each side of the disk.

# Sectors Remaining = Number of formatted sectors left which can be read, including side 1 of the disk if MT is set to "1".

**TABLE 11-22: VERIFY COMMAND RESULT PHASE**

MT	EC	SC/EOT Value	Termination Result
0	0	SC = DTL EOT <= # Sectors Per Side	Success Termination Result Phase Valid
0	0	SC = DTL EOT > # Sectors Per Side	Unsuccessful Termination Result Phase Invalid
0	1	SC <= # Sectors Remaining AND EOT <= # Sectors Per Side	Successful Termination Result Phase Valid
0	1	SC > # Sectors Remaining OR EOT > # Sectors Per Side	Unsuccessful Termination Result Phase Invalid
1	0	SC = DTL EOT <= # Sectors Per Side	Successful Termination Result Phase Valid
1	0	SC = DTL EOT > # Sectors Per Side	Unsuccessful Termination Result Phase Invalid
1	1	SC <= # Sectors Remaining AND EOT <= # Sectors Per Side	Successful Termination Result Phase Valid
1	1	SC > # Sectors Remaining OR EOT > # Sectors Per Side	Unsuccessful Termination Result Phase Invalid

**Note 11-3** If MT is set to "1" and the SC value is greater than the number of remaining formatted sectors on Side 0, verifying will continue on Side 1 of the disk.

## 11.9.7 FORMAT A TRACK

The Format command allows an entire track to be formatted. After a pulse from the INDEX# pin is detected, the FDC starts writing data on the disk including gaps, address marks, ID fields, and data fields per the IBM System 34 or 3740 format (MFM or FM respectively). The particular values that will be written to the gap and data field are controlled by the values programmed into N, SC, GPL, and D which are specified by the host during the command phase. The data field of the sector is filled with the data byte specified by D. The ID field for each sector is supplied by the host; that is, four data bytes per sector are needed by the FDC for C, H, R, and N (cylinder, head, sector number and sector size respectively).

After formatting each sector, the host must send new values for C, H, R and N to the FDC for the next sector on the track. The R value (sector number) is the only value that must be changed by the host after each sector is formatted. This allows the disk to be formatted with nonsequential sector addresses (interleaving). Incrementing and formatting continues for the whole track until the FDC encounters a pulse on the INDEX# pin again and terminates the command.

[Table 11-24 on page 128](#) contains typical values for gap fields which are dependent upon the size of the sector and the number of sectors on each track. Actual values can vary due to drive electronics.

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**TABLE 11-23: FORMAT FIELDS**

SYSTEM 34 (DOUBLE DENSITY) FORMAT																		
GAP4a 80x 4E	SYNC 12x 00	IAM		GAP 1 50x 4E	SYNC 12x 00	IDAM	C Y L	H D	S E C	N O	C R C	GAP 2 22x 4E	SYNC 12x 00	DATA AM	DATA	C R C	GAP 3	GAP 4b
		3x C 2	F C			3x A 1	F E							3x A 1	F B F8			
SYSTEM 3740 (SINGLE DENSITY) FORMAT																		
GAP4a 40x FF	SYNC 6x 00	IAM		GAP 1 26x FF	SYNC 6x 00	IDAM	C Y L	H D	S E C	N O	C R C	GAP 2 11x FF	SYNC 6x 00	DATA AM	DATA	C R C	GAP 3	GAP 4b
		FC				FE								FB or F8				
PERPENDICULAR FORMAT																		
GAP4a 80x 4E	SYNC 12x 00	IAM		GAP 1 50x 4E	SYNC 12x 00	IDAM	C Y L	H D	S E C	N O	C R C	GAP 2 41x 4E	SYNC 12x 00	DATA AM	DATA	C R C	GAP 3	GAP 4b
		3x C 2	F C			3x A 1	F E							3x A 1	F B F8			

**TABLE 11-24: TYPICAL VALUES FOR FORMATTING**

	Format	Sector Size	N	SC	GPL1	GPL2
5.25" Drives	FM	128	00	12	07	09
		128	00	10	10	19
		512	02	08	18	30
		1024	03	04	46	87
		2048	04	02	C8	FF
		4096	05	01	C8	FF
		...	...			
	MFM	256	01	12	0A	0C
		256	01	10	20	32
		512*	02	09	2A	50
		1024	03	04	80	F0
		2048	04	02	C8	FF
		4096	05	01	C8	FF
		...	...			
3.5" Drives	FM	128	0	0F	07	1B
		256	1	09	0F	2A
		512	2	05	1B	3A
3.5" Drives	MFM	256	1	0F	0E	36
		512**	2	09	1B	54
		1024	3	05	35	74

GPL1 = suggested GPL values in Read and Write commands to avoid splice point between data field and ID field of contiguous sections.

GPL2 = suggested GPL value in Format A Track command.

\*PC/AT values (typical)

\*\*PS/2 values (typical). Applies with 1.0 MB and 2.0 MB drives.

**Note:** All values except sector size are in hex.



## 11.9.8 CONTROL COMMANDS

Control commands differ from the other commands in that no data transfer takes place. Three commands generate an interrupt when complete: Read ID, Recalibrate, and Seek. The other control commands do not generate an interrupt.

### Read ID

The Read ID command is used to find the present position of the recording heads. The FDC stores the values from the first ID field it is able to read into its registers. If the FDC does not find an ID address mark on the diskette after the second occurrence of a pulse on the INDEX# pin, it then sets the IC code in Status Register 0 to "01" (abnormal termination), sets the MA bit in Status Register 1 to "1", and terminates the command.

The following commands will generate an interrupt upon completion. They do not return any result bytes. It is highly recommended that control commands be followed by the Sense Interrupt Status command. Otherwise, valuable interrupt status information will be lost.

### Recalibrate

The Recalibrate Command causes the read/write head within the FDC to retract to the track 0 position. The FDC clears the contents of the PCN counter and checks the status of the TRK0# pin from the FDD. As long as the TRK0# pin is low, the DIR pin remains 0 and step pulses are issued. When the TRK0# pin goes high, the SE bit in Status Register 0 is set to "1" and the command is terminated. If the TRK0# pin is still low after 79 step pulses have been issued, the FDC sets the SE and the EC bits of Status Register 0 to "1" and terminates the command. Disks capable of handling more than 80 tracks per side may require more than one Recalibrate command to return the head back to physical Track 0.

This command does not have a result phase. The Sense Interrupt Status command must be issued after the Recalibrate command to effectively terminate it and provide verification of the head position (PCN). During the command phase of the recalibrate operation, the FDC is in the BUSY state, but during the execution phase it is in a NON-BUSY state. At this time, another Recalibrate command may be issued, and in this manner parallel Recalibrate operations may be done on up to four drives at once. Upon power up, the software must issue a Recalibrate command to properly initialize all drives and the controller.

### Seek

The read/write head within the drive is moved from track to track under the control of the Seek command. The FDC compares the PCN, which is the current head position, with the NCN and performs the following operation if there is a difference:

- PCN < NCN: Direction signal to drive set to "1" (step in) and issues step pulses.
- PCN > NCN: Direction signal to drive set to "0" (step out) and issues step pulses.

The rate at which step pulses are issued is controlled by SRT (Stepping Rate Time) in the Specify command. After each step pulse is issued, NCN is compared against PCN, and when NCN = PCN the SE bit in Status Register 0 is set to "1" and the command is terminated. During the command phase of the seek or recalibrate operation, the FDC is in the BUSY state, but during the execution phase it is in the NON-BUSY state. At this time, another Seek or Recalibrate command may be issued, and in this manner, parallel seek operations may be done on up to four drives at once.

Note that if implied seek is not enabled, the read and write commands should be preceded by:

1. Seek command - Step to the proper track
2. Sense Interrupt Status command - Terminate the Seek command
3. Read ID - Verify head is on proper track
4. Issue Read/Write command.

The Seek command does not have a result phase. It is highly recommended that the Sense Interrupt Status command is issued after the Seek command to terminate it and provide verification of the head position (PCN). The H bit (Head Address) in ST0 will always return to a "0". When exiting POWERDOWN mode, the FDC clears the PCN value and the status information to zero. Prior to issuing the POWERDOWN command, it is highly recommended that the user service all pending interrupts through the Sense Interrupt Status command.

## 11.10 Sense Interrupt Status

An interrupt signal is generated by the FDC for one of the following reasons:

1. Upon entering the Result Phase of:
  - a) Read Data command
  - b) Read A Track command
  - c) Read ID command

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- d) Read Deleted Data command
- e) Write Data command
- f) Format A Track command
- g) Write Deleted Data command
- h) Verify command
- 2. End of Seek, Relative Seek, or Recalibrate command

The Sense Interrupt Status command resets the interrupt signal and, via the IC code and SE bit of Status Register 0, identifies the cause of the interrupt.

**TABLE 11-25: INTERRUPT IDENTIFICATION**

SE	IC	Interrupt Due to
0	11	Polling
1	00	Normal termination of Seek or Recalibrate command
1	01	Abnormal termination of Seek or Recalibrate command

The Seek, Relative Seek, and Recalibrate commands have no result phase. The Sense Interrupt Status command must be issued immediately after these commands to terminate them and to provide verification of the head position (PCN). The H (Head Address) bit in ST0 will always return a "0". If a Sense Interrupt Status is not issued, the drive will continue to be BUSY and may affect the operation of the next command.

### Sense Drive Status

Sense Drive Status obtains drive status information. It has no execution phase and goes directly to the result phase from the command phase. Status Register 3 contains the drive status information.

### Specify

The Specify command sets the initial values for each of the three internal times. The HUT (Head Unload Time) defines the time from the end of the execution phase of one of the read/write commands to the head unload state. The SRT (Step Rate Time) defines the time interval between adjacent step pulses. Note the spacing between the first and second step pulses may be shorter than the remaining step pulses. The HLT (Head Load Time) defines the time between when the Head Load signal goes high and the read/write operation starts. The values change with the data rate speed selection and are documented in Table 11-26. The values are the same for MFM and FM.

DMA operation is selected by the ND bit. When ND is "0", the DMA mode is selected. This part does not support non-DMA mode. In DMA mode, data transfers are signaled by the DMA request cycles.

### Configure

The Configure command is issued to select the special features of the FDC. A Configure command need not be issued if the default values of the FDC meet the system requirements.

**TABLE 11-26: DRIVE CONTROL DELAYS (MS)**

	HUT					SRT				
	2M	1M	500K	300K	250K	2M	1M	500K	300K	250K
0	64	128	256	426	512	4	8	16	26.7	32
1	4	8	16	26.7	32	3.75	7.5	15	25	30
...	...	...	...	...	...	...	...	...	...	...
E	56	112	224	373	448	0.5	1	2	3.33	4
F	60	120	240	400	480	0.25	0.5	1	1.67	2

	HLT				
	2M	1M	500K	300K	250K
00	64	128	256	426	512
01	0.5	1	2	3.3	4
02	1	2	4	6.7	8
...	...	...	...	...	...
7F	63	126	252	420	504
7F	63.5	127	254	423	508

## Configure Default Values:

EIS - No Implied Seeks

EFIFO - FIFO Disabled

POLL - Polling Enabled

FIFOTHR - FIFO Threshold Set to 1 Byte

PRETRK - Pre-Compensation Set to Track 0

EIS - Enable Implied Seek. When set to "1", the FDC will perform a Seek operation before executing a read or write command. Defaults to no implied seek.

EFIFO - A "1" disables the FIFO (default). This means data transfers are asked for on a byte-by-byte basis. Defaults to "1", FIFO disabled. The threshold defaults to "1".

POLL - Disable polling of the drives. Defaults to "0", polling enabled. When enabled, a single interrupt is generated after a reset. No polling is performed while the drive head is loaded and the head unload delay has not expired.

FIFOTHR - The FIFO threshold in the execution phase of read or write commands. This is programmable from 1 to 16 bytes. Defaults to one byte. A "00" selects one byte; "0F" selects 16 bytes.

PRETRK - Pre-Compensation Start Track Number. Programmable from track 0 to 255. Defaults to track 0. A "00" selects track 0; "FF" selects track 255.

## Version

The Version command checks to see if the controller is an enhanced type or the older type (765A). A value of 90 H is returned as the result byte.

## Relative Seek

The command is coded the same as for Seek, except for the MSB of the first byte and the DIR bit.

DIR Head Step Direction Control

RCN Relative Cylinder Number that determines how many tracks to step the head in or out from the current track number.

DIR	Action
0	Step Head Out
1	Step Head In

The Relative Seek command differs from the Seek command in that it steps the head the absolute number of tracks specified in the command instead of making a comparison against an internal register. The Seek command is good for drives that support a maximum of 256 tracks. Relative Seeks cannot be overlapped with other Relative Seeks. One Relative Seek can be active at a time. Relative Seeks may be overlapped with Seeks and Recalibrates. Bit 4 of Status Register 0 (EC) will be set if Relative Seek attempts to step outward beyond Track 0.

As an example, assume that a floppy drive has 300 usable tracks. The host needs to read track 300 and the head is on any track (0-255). If a Seek command is issued, the head will stop at track 255. If a Relative Seek command is issued, the FDC will move the head the specified number of tracks, regardless of the internal cylinder position register (but will increment the register). If the head was on track 40 (D), the maximum track that the FDC could position the head on using Relative Seek will be 295 (D), the initial track + 255 (D). The maximum count that the head can be moved with a single Relative Seek command is 255 (D).

The internal register, PCN, will overflow as the cylinder number crosses track 255 and will contain 39 (D). The resulting PCN value is thus  $(RCN + PCN) \bmod 256$ . Functionally, the FDC starts counting from 0 again as the track number goes above 255 (D). It is the user's responsibility to compensate FDC functions (precompensation track number) when accessing tracks greater than 255. The FDC does not keep track that it is working in an "extended track area" (greater than 255). Any command issued will use the current PCN value except for the Recalibrate command, which only looks for the TRACK0 signal. Recalibrate will return an error if the head is farther than 79 due to its limitation of issuing a maximum of 80 step pulses. The user simply needs to issue a second Recalibrate command. The Seek command and implied seeks will function correctly within the 44 (D) track (299-255) area of the "extended track area". It is the user's responsibility not to issue a new track position that will exceed the maximum track that is present in the extended area.

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To return to the standard floppy range (0-255) of tracks, a Relative Seek should be issued to cross the track 255 boundary.

A Relative Seek can be used instead of the normal Seek, but the host is required to calculate the difference between the current head location and the new (target) head location. This may require the host to issue a Read ID command to ensure that the head is physically on the track that software assumes it to be. Different FDC commands will return different cylinder results which may be difficult to keep track of with software without the Read ID command.

## Perpendicular Mode

The Perpendicular Mode command should be issued prior to executing Read/Write/Format commands that access a disk drive with perpendicular recording capability. With this command, the length of the Gap2 field and VCO enable timing can be altered to accommodate the unique requirements of these drives. [Table 11-27 on page 133](#) describes the effects of the WGATE and GAP bits for the Perpendicular Mode command. Upon a reset, the FDC will default to the conventional mode (WGATE = 0, GAP = 0).

Selection of the 500 Kbps and 1 Mbps perpendicular modes is independent of the actual data rate selected in the Data Rate Select Register. The user must ensure that these two data rates remain consistent.

The Gap2 and VCO timing requirements for perpendicular recording type drives are dictated by the design of the read/write head. In the design of this head, a pre-erase head precedes the normal read/write head by a distance of 200 micrometers. This works out to about 38 bytes at a 1 Mbps recording density. Whenever the write head is enabled by the Write Gate signal, the pre-erase head is also activated at the same time. Thus, when the write head is initially turned on, flux transitions recorded on the media for the first 38 bytes will not be preconditioned with the pre-erase head since it has not yet been activated. To accommodate this head activation and deactivation time, the Gap2 field is expanded to a length of 41 bytes. The Format Fields table illustrates the change in the Gap2 field size for the perpendicular format.

On the read back by the FDC, the controller must begin synchronization at the beginning of the sync field. For the conventional mode, the internal PLL VCO is enabled (VCOEN) approximately 24 bytes from the start of the Gap2 field. But, when the controller operates in the 1 Mbps perpendicular mode (WGATE = 1, GAP = 1), VCOEN goes active after 43 bytes to accommodate the increased Gap2 field size. For both cases, an approximate two-byte cushion is maintained from the beginning of the sync field for the purposes of avoiding write splices in the presence of motor speed variation.

For the Write Data case, the FDC activates Write Gate at the beginning of the sync field under the conventional mode. The controller then writes a new sync field, data address mark, data field, and CRC. With the pre-erase head of the perpendicular drive, the write head must be activated in the Gap2 field to insure a proper write of the new sync field. For the 1 Mbps perpendicular mode (WGATE = 1, GAP = 1), 38 bytes will be written in the Gap2 space. Since the bit density is proportional to the data rate, 19 bytes will be written in the Gap2 field for the 500 Kbps perpendicular mode (WGATE = 1, GAP = 0).

It should be noted that none of the alterations in Gap2 size, VCO timing, or Write Gate timing affect normal program flow. The information provided here is just for background purposes and is not needed for normal operation. Once the Perpendicular Mode command is invoked, FDC software behavior from the user standpoint is unchanged.

The perpendicular mode command is enhanced to allow specific drives to be designated Perpendicular recording drives. This enhancement allows data transfers between Conventional and Perpendicular drives without having to issue Perpendicular mode commands between the accesses of the different drive types, nor having to change write pre-compensation values.

When both GAP and WGATE bits of the PERPENDICULAR MODE COMMAND are both programmed to "0" (Conventional mode), then D0, D1, D2, D3, and D4 can be programmed independently to "1" for that drive to be set automatically to Perpendicular mode. In this mode the following set of conditions also apply:

- The GAP2 written to a perpendicular drive during a write operation will depend upon the programmed data rate.
- The write pre-compensation given to a perpendicular mode drive will be 0ns.
- For D0-D3 programmed to "0" for conventional mode drives any data written will be at the currently programmed write pre-compensation.

**Note 11-4** Bits D0-D3 can only be overwritten when OW is programmed as a "1". If either GAP or WGATE is a "1" then D0-D3 are ignored.

Software and hardware resets have the following effect on the PERPENDICULAR MODE COMMAND:

1. "Software" resets (via the DOR or DSR registers) will only clear GAP and WGATE bits to "0". D0-D3 are unaffected and retain their previous value.
2. "Hardware" resets will clear all bits (GAP, WGATE and D0-D3) to "0", i.e. all conventional mode.

**TABLE 11-27: EFFECTS OF WGATE AND GAP BITS**

WGATE	Gap	Mode	Length of GAP2 Format Field	Portion of GAP 2 Written by Write Data Operation
0	0	Conventional	22 Bytes	0 Bytes
0	1	Perpendicular (500 Kbps)	22 Bytes	19 Bytes
1	0	Reserved (Conventional)	22 Bytes	0 Bytes
1	1	Perpendicular (1 Mbps)	41 Bytes	38 Bytes

## Lock

In order to protect systems with long DMA latencies against older application software that can disable the FIFO the LOCK Command has been added. This command should only be used by the FDC routines, and application software should refrain from using it. If an application calls for the FIFO to be disabled then the CONFIGURE command should be used.

The LOCK command defines whether the EFIFO, FIFOTHR, and PRETRK parameters of the CONFIGURE command can be RESET by the DOR and DSR registers. When the LOCK bit is set to logic “1” all subsequent “software RESETS by the DOR and DSR registers will not change the previously set parameters to their default values. All “hardware” RESET from the PCI RESET# pin will set the LOCK bit to logic “0” and return the EFIFO, FIFOTHR, and PRETRK to their default values. A status byte is returned immediately after issuing a LOCK command. This byte reflects the value of the LOCK bit set by the command byte.

## Enhanced Dumpreg

The DUMPREG command is designed to support system run-time diagnostics and application software development and debug. To accommodate the LOCK command and the enhanced PERPENDICULAR MODE command the eighth byte of the DUMPREG command has been modified to contain the additional data from these two commands.

## 11.11 Compatibility

The SCH5627P was designed with software compatibility in mind. It is a fully backwards- compatible solution with the older generation 765A/B disk controllers. The FDC also implements on-board registers for compatibility with the PS/2, as well as PC/AT and PC/XT, floppy disk controller subsystems. After a hardware reset of the FDC, all registers, functions and enhancements default to a PC/AT, PS/2 or PS/2 Model 30 compatible operating mode, depending on how the IDENT and MFM bits are configured by the system BIOS.

## 11.12 Floppy Drive Presence Detection

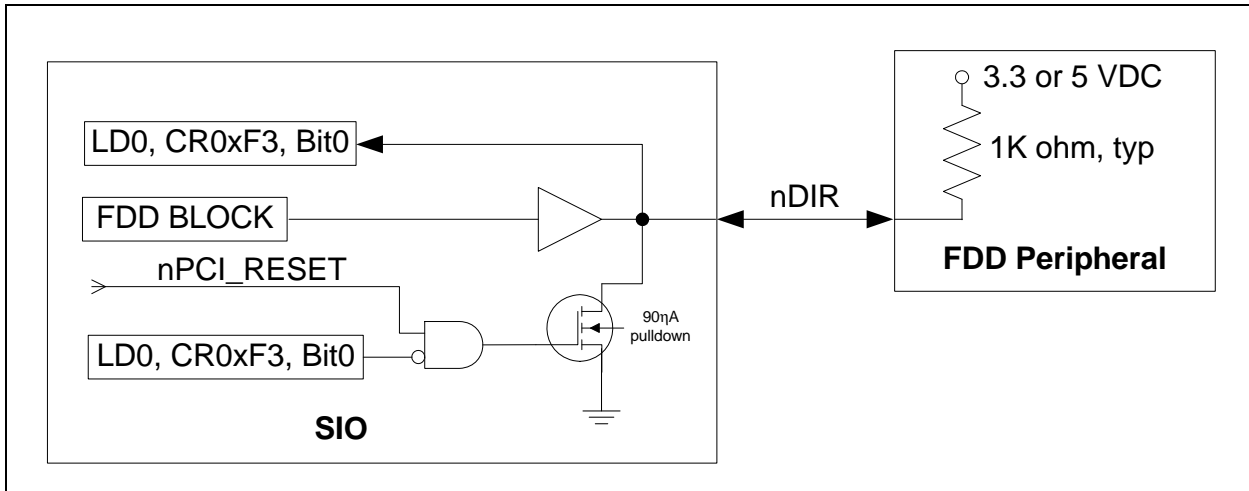
The Floppy Drive Presence Detection Circuit is illustrated in [Figure 11-1](#). The nDIR pin is an output pin on the SCH5627P Floppy Interface. Standard Floppy Peripherals have a strong pull-ups on this pin. The SCH5627P has an on chip 90µA weak pull-down which is selectively activated to detect the presence of the nDIR pull-up from the Floppy peripheral. The 90µA weak pull-down is deactivated when PCI RESET# is asserted or once the Floppy activate bit (LD0,CR0x30-bit0) is set to ‘1’.

The state of the nDIR pin is reported to the FDSTAT bit at LD0,CR0xF3-bit0. See [Section 11.12.1, "FDSTAT Register," on page 134](#).

**APPLICATION NOTE:** The programmer can read the state of the FDSTAT bit at LD0,CR0xF3-bit0, If this bit is set to ‘1’, the a FDD is present and in the normal course of initializing the floppy, the programmer will set the Floppy activate bit (LD0,CR0xF3-bit0) is set to ‘1’.

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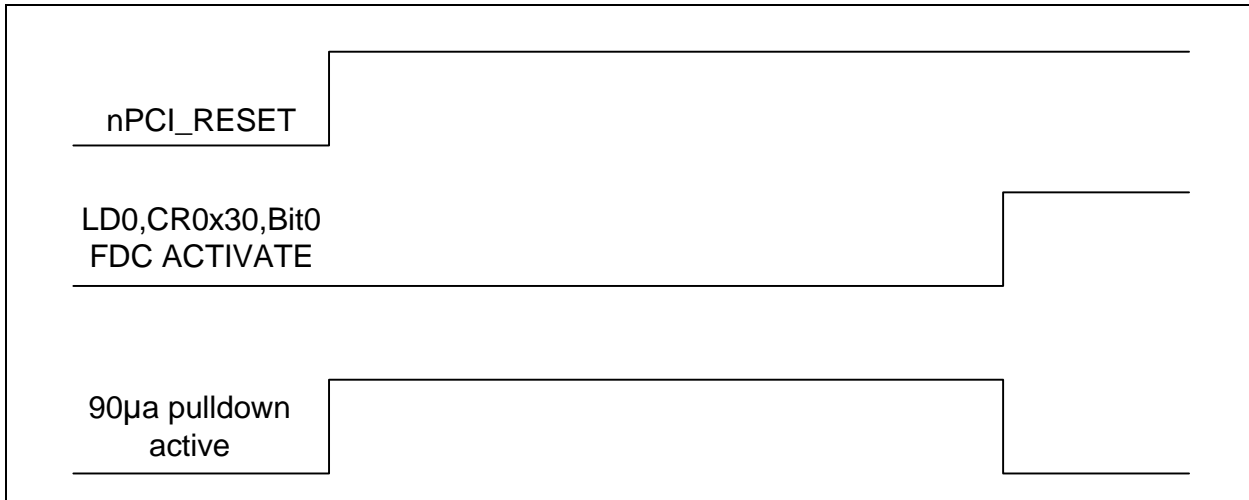
**FIGURE 11-1: FLOPPY DRIVE PRESENCE DETECTION CIRCUIT**



**Note:** Figure 11-1 is intended for illustration purposes only and does not portray specific implementation details.

**Note 11-5** The nDIR buffer defaults to open drain. The nDIR can be configured to be push-pull via LD0,CR0xF0-bit6. The FDSTAT bit at LD0,CR0xF3-bit0 is reliable only if nDIR is open drain; therefore, LD0,CR0xF0-bit6 should remain clear until after the Floppy has been detected.

**FIGURE 11-2: NDIR WEAK PULL-DOWN ACTIVATION TIMING**



## 11.12.1 FDSTAT REGISTER

The register FDSTAT is in the Configuration space at Logical Device 0, Index 0xF3.

- Bit 0: FDPRES indicates whether a floppy drive has been detected: '1' means that at least one drive is present, and '0' means that no drive is present.
- Bits 1 through 7, reserved for future use. Read-only, read as zero always.

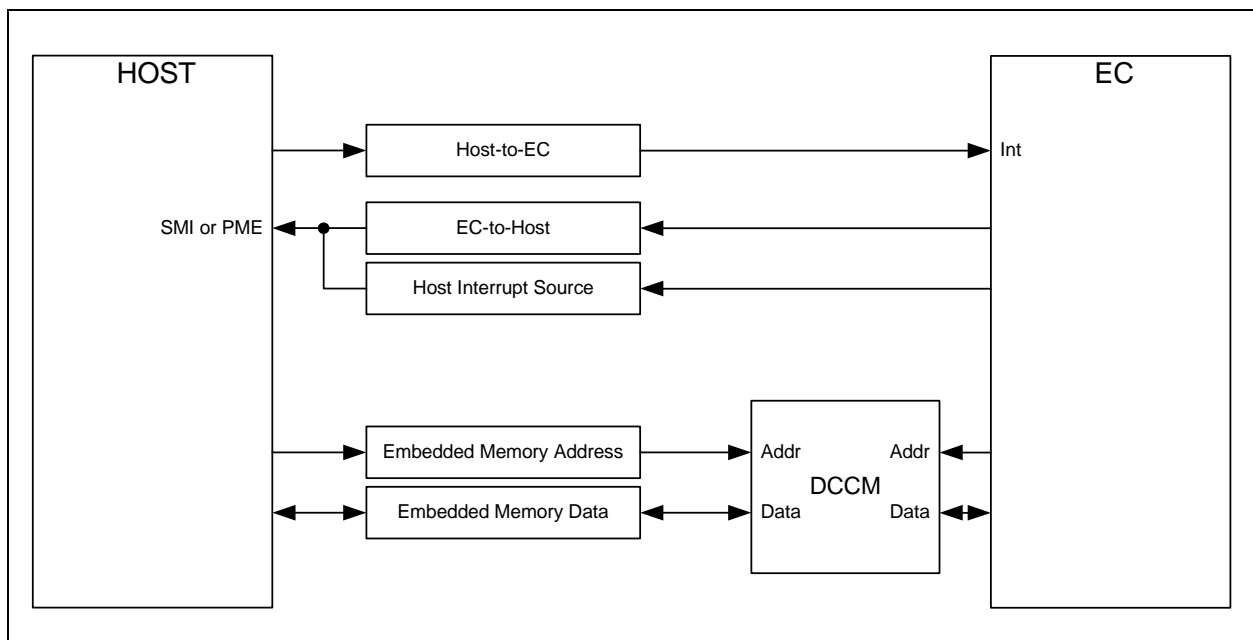
## 12.0 EMBEDDED MEMORY INTERFACE

### 12.1 General Description

The [Embedded Memory Interface](#) provides a standard run-time mechanism for the host to communicate with the Embedded Controller (EC) and other logical components in the SCH5627P Block Diagram. The Embedded Memory Interface includes 12 byte-addressable registers in the Host's I/O address space, as well as 20 bytes of registers that are accessible only by the EC. The Embedded Memory Interface can be used by the Host to read any byte in a region of EC closely-coupled memory, designated by the EC, without requiring any assistance from the EC. In addition, a portion of the memory can be configured so that it can be written by the Host without any EC assistance.

#### 12.1.1 BLOCK DIAGRAM

**FIGURE 12-1: EMBEDDED MEMORY INTERFACE BLOCK DIAGRAM**



### 12.2 Reset

This block is reset when `nSYS_RST` is asserted.

### 12.3 Interrupts

The Host can generate interrupt events to the EC, as described in [Section 12.3.1, "EC Interrupts"](#). In addition, the EC can generate events to the Host, either directly through a SERIRQ, or in conjunction with the PME/SMI logic. The EC to Host interrupts are described in [Section 12.3.2, "Embedded Memory Interface SERIRQ Routing"](#) and in [Section 12.3.3, "Embedded Memory Interface PME/SMI Routing"](#) and illustrated in [FIGURE 16-1: SMI/PME Interrupt Routing on page 150](#).

#### 12.3.1 EC INTERRUPTS

The [Embedded Memory Interface](#) can generate an interrupt event for HOST-to-EC events. See the [HOST-to-EC Mailbox Register on page 140](#). The interrupt for the EMI is routed onto the `EM_Int` bit in the [GIRQ15 Source register](#).

#### 12.3.2 EMBEDDED MEMORY INTERFACE SERIRQ ROUTING

The EC can use the [Embedded Memory Interface](#) to generate SERIRQ events for EC-to-HOST EC events. There are two methods by which the EC generates SERIRQ events to the Host: writes to the [EC-to-Host Mailbox Register](#), and writes to the `EC_SWI` bits in the [Interrupt Source Register](#).

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Writes to the [EC-to-Host Mailbox Register](#) generate an interrupt that is routed to the SERIRQ block (see [Section 7.6.1, "SERIRQ Configuration Registers," on page 43](#)). For this interrupt, the SELECT bit is set to '0' in the Interrupt Configuration Register. This interrupt signal is an active high level interrupt, so the selected SERIRQ channel will be high when the EM interrupt is asserted.

The EC can also generate an event by setting to 1 any of the [EC\\_SWI](#) bits in the [Interrupt Source Register](#) that are enabled by a 1 in the corresponding [EC\\_SWI\\_EN](#) bits in the [Interrupt Mask Register](#). This event is also asserted by a write to the [EC-to-Host Mailbox Register](#) if the [EC\\_WR\\_EN](#) is 1. The event can be routed to any frame in the SERIRQ stream. For this interrupt, the SELECT bit is set to '1' in the Interrupt Configuration Register. This interrupt signal is active low, so the selected SERIRQ channel will be low when the EM interrupt is asserted. The assertion level matches the level of the IO\_SMI# pin, when an SMI is asserted through the Runtime Registers block because of the EMI software interrupt bits.

## 12.3.3 EMBEDDED MEMORY INTERFACE PME/SMI ROUTING

The two signals from the EMI that are used to generate SERIRQ events can also be used to generate either PME or SMI events.

EM\_EVT1 is asserted when the EC writes the [EC-to-Host Mailbox Register](#). EM\_EVT1 is an active high level, and is equivalent to the SELECT=0 SERIRQ interrupt. EM\_EVT2 is asserted when any of the [EC\\_SWI](#) bits in the [Interrupt Source Register](#) is 1 when there is a corresponding 1 bit in the [EC\\_SWI\\_EN](#) field in the [Interrupt Mask Register](#). EM\_EVT2 is also asserted by a write to the [EC-to-Host Mailbox Register](#) if the [EC\\_WR\\_EN](#) is 1. EM\_EVT2 is active high level and is therefore the inverse of the SELECT=1 SERIRQ interrupt. EM\_EVT1 and EM\_EVT2 are routed to the PME and SMI runtime registers, where they can be enabled for event generation. See [Section 16.0, "Runtime Registers," on page 149](#) for details.

## 12.4 Description

The Embedded Memory Interface contains a Mailbox that enables the Host to send an 8-bit message to the EC and the EC to send an 8-bit message to the Host. When written by the sender, the messages can generate an interrupt at the receiver.

In addition to the messages that can be exchanged, the Embedded Memory Interface permits the Host to read and write a portion of the EC's Data Closely Coupled Memory (DCCM). Host reads and writes take place without intervention or assistance from the EC.

The Embedded Memory Interface occupies 12 bytes in the Host I/O space. Two bytes constitute the Host-to-EC and EC-to-Host message links. Six bytes are used for the interface into the EC DCCM, two for address and four for data. The four data bytes are used for reads and writes to the EC DCCM using the EC's Direct Memory Interface (DMI).

When the Host reads one of the four bytes in the Embedded Memory Interface data register, data from the DCCM at the address defined by the Embedded Memory Interface address register is returned to the Host. Writes to a byte write the corresponding byte in the DCCM. The Embedded Memory Interface can be configured so that, although Host I/O is always byte at a time, transfers between the Embedded Memory Interface data bytes and the DCCM can be configured to occur as single bytes, 2-byte blocks or 4-byte blocks. This is done so that data that the EC treats as 16-bit or 32-bit will be consistent in the Host, even though one byte of the DCCM data may change between two or more 8-bit accesses by the Host.

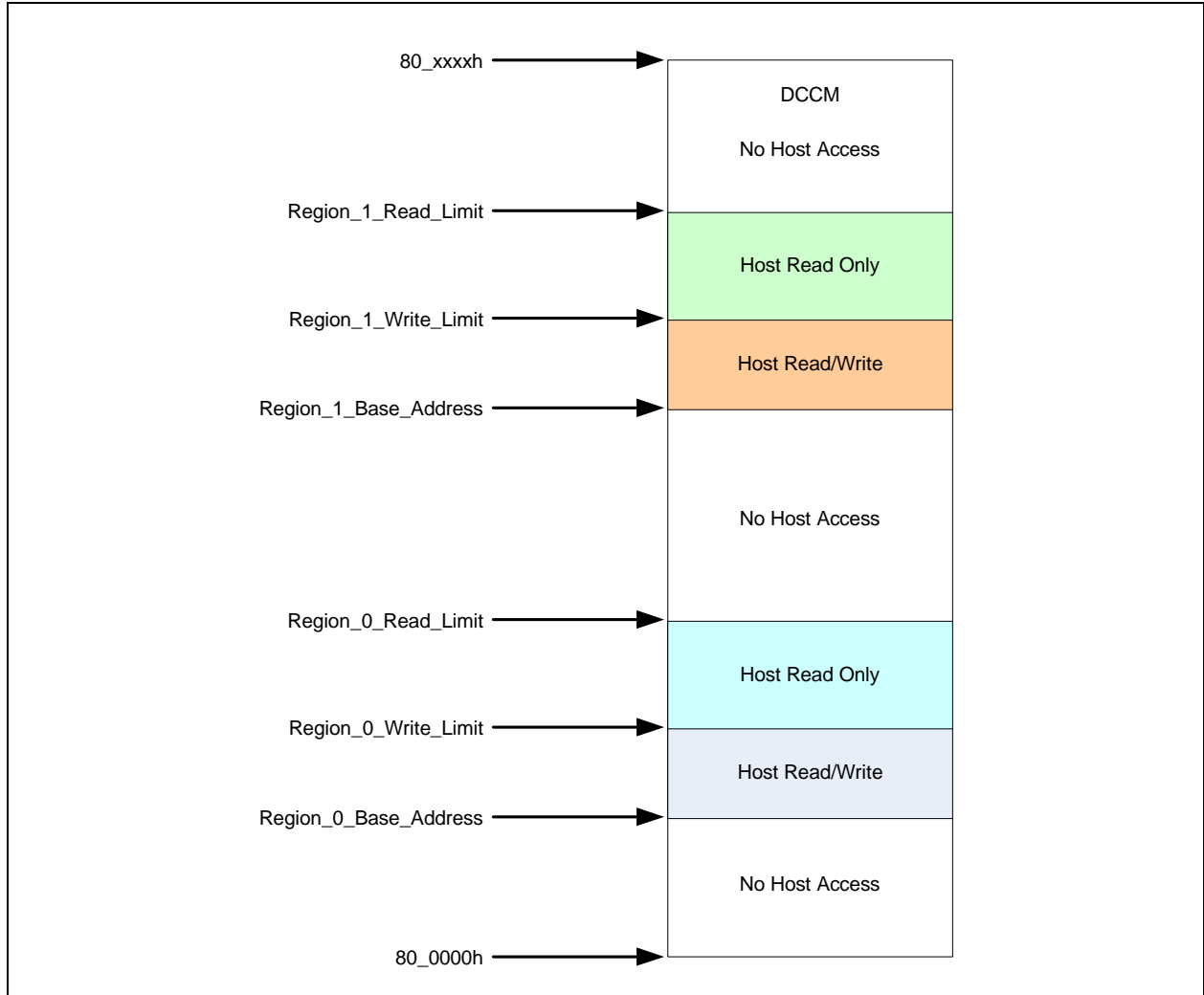
In addition, there is an auto-increment function for the Embedded Memory Interface address register. When enabled, the Host can read or write blocks of memory in the DCCM by repeatedly accessing the Embedded Memory Interface data register, without requiring Host updates to the Embedded Memory Interface address register.



## 12.4.1 EMBEDDED MEMORY MAP

Each Embedded Memory interface provides direct access for the Host into two windows in the EC DCCM SRAM. This mapping is shown in Figure 12-2, "Embedded Memory Addressing":

**FIGURE 12-2: EMBEDDED MEMORY ADDRESSING**

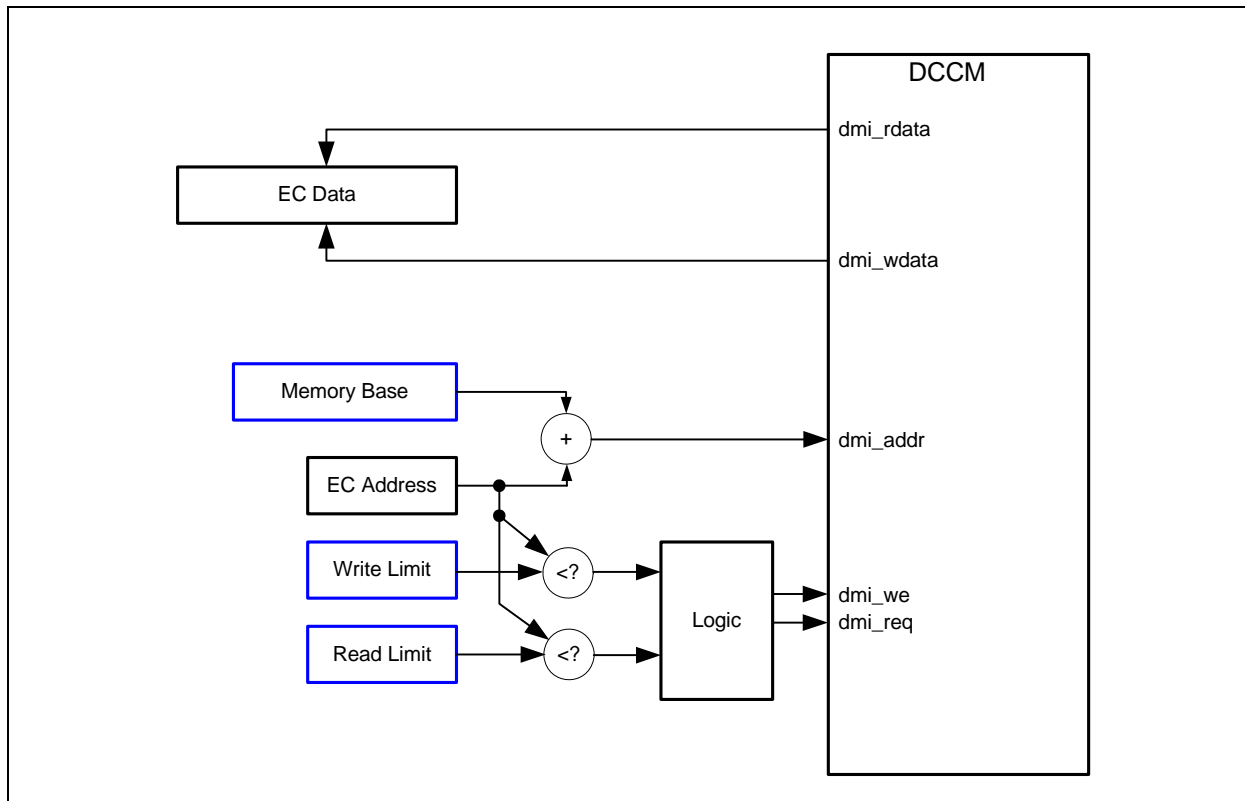


The Base addresses, the Read limits and the Write limits are defined by registers that are in the EC address space and cannot be accessed by the Host. In each region, the Read limit need not be greater than the Write limit. The regions can be contiguous or overlapping. For example, if the Region 0 Read limit is set to 0 and the Write limit is set to a positive number, then the Embedded Memory interface defines a region in the EC memory that the EC can read and write but is write-only for the host. This might be useful for storage of security data, which the Host might wish to send to the EC but should not be readable in the event a virus invades the Host.

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Each window into the EC memory can be as large as the DCCM. The Embedded Memory Interface uses the EC's DCCM Direct Memory Interface (DMI) in order to access the memory. Figure 12-3, "Embedded Memory Region Address Control" shows the relationship between one off the regions in the Embedded Memory Interface and the DCCM DMI:

**FIGURE 12-3: EMBEDDED MEMORY REGION ADDRESS CONTROL**



## 12.4.2 EMBEDDED MEMORY INTERFACE USAGE

The Embedded Memory Interface provides a generic facility for communication between the Host and the EC and can be used for many functions. Some examples are:

- Virtual registers. A block of read-only memory locations in the DCCM can be used to implement a set of virtual registers. The EC can update these locations with that the Host can later read.
- Program downloading. Because the Instruction Closely Coupled Memory is implemented in the same SRAM as the DCCM, the Embedded Memory Interface can be used by the Host to download new program segments for the EC. The Read/Write window would be configured by the Host to point to the beginning of the loadable program region, which could then be loaded by the Host.
- Data exchange. The Read/Write portion of the memory window can be used to contain a communication packet. The Host, by default, "owns" the packet, and can write it at any time. When the Host wishes to communicate with the EC, it sends the EC a command, through the Host-to-EC message facility, to read the packet and perform some operations as a result. When it is completed processing the packet, the EC can inform the Host, either through a message in the EC-to-Host channel or by triggering an event such as an SMI directly. If return results are required, the EC can write the results into the Read/Write region, which the Host can read directly when it is informed that the EC has completed processing. Depending on the command, the operations could entail update of virtual registers in the DCCM, reads of any register in the EC address space, or writes of any register in the EC address space. Because there are two regions that are defined by the base registers, the memory used for the communication packet does not have to be contiguous with a set of virtual registers.

Because there are two Embedded Memory Interface memory regions, the Embedded Memory Interface cannot be used for more than two of these functions at a time. The Host can request that the EC switch from one function to another through the use of the Host-to-EC mailbox register.

The [Application ID Register](#) is provided to help software applications track ownership of an Embedded Memory Interface. An application can write the [Application ID Register](#) with its Application ID, then immediately read it back. If the read value is not the same as the value written, then another application has ownership of the interface.

**Note:** The protocol used to pass commands back and forth through the Embedded Memory Interface Registers Interface is left to the System designer. Microchip can provide an application example of working code in which the host uses the Embedded Memory Interface registers to gain access to all of the EC registers.

## 12.5 Registers

The [Table 12-1](#) is a register summary for the [Embedded Memory Interface](#). The LPC I/O address for each Run-Time Register is described below as an offset from its Base Address Register.

**TABLE 12-1: EMBEDDED MEMORY INTERFACE REGISTER SUMMARY**

Register Name	I/O Offset	Size	Type	Notes
<b>RUNTIME REGISTERS</b>				
<a href="#">HOST-to-EC Mailbox Register</a>	00h	8	R/W	<a href="#">Note 12-1</a>
<a href="#">EC-to-Host Mailbox Register</a>	01h	8	R/WC	<a href="#">Note 12-2</a>
<a href="#">EC Address Register</a>	02h	8	R/W	
	03h	8		
<a href="#">EC Data Register</a>	04h	8	R/W	
	05h	8		
	06h	8		
	07h	8		
<a href="#">Interrupt Source Register</a>	08h	8	R/WC	
	09h	8		
<a href="#">Interrupt Mask Register</a>	0Ah	8	R/W	
	0Bh	8		
<a href="#">Application ID Register</a>	0Ch	8	R/W	

**Note 12-1** Interrupt is cleared when read by the EC.

**Note 12-2** Interrupt is cleared when read by the host.

### 12.5.1 EMBEDDED MEMORY INTERFACE CONTROL REGISTERS

Mailbox Register, HOST-to-EC, and Mailbox Register, EC-to-HOST, are specifically designed to pass commands between the host and the EC. If enabled, these registers can generate interrupts.

When the host performs a write of the HOST-to-EC mailbox register, an interrupt will be generated and seen by the EC if unmasked.

When the EC writes the EC-to-HOST mailbox register, an SIRQ event or an event such as SMI or PME may be generated and seen by the host if unmasked.

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## 12.6 Registers

### 12.6.1 HOST-TO-EC MAILBOX REGISTER

**TABLE 12-2: HOST-TO-EC MAILBOX REGISTER**

<b>HOST OFFSET</b>	00h						8-Bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	HOST_EC_MBOX[7:0]								

### HOST\_EC\_MBOX

If enabled, an interrupt to the EC marked by the [EM](#) bit in the [GIRQ15](#) Source register will be generated whenever the Host writes this register. The Host and the EC can read and write this register at offset 000h.

Writes of a 1 to any bit in this register by the EC to this register will cause the bit to be cleared. Writes of a 0 to any bit have no effect.

### 12.6.2 EC-TO-HOST MAILBOX REGISTER

**TABLE 12-3: EC-TO-HOST MAILBOX REGISTER**

<b>HOST OFFSET</b>	01h						8-Bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	
<b>BIT NAME</b>	EC_HOST_MBOX[7:0]								

### EC\_HOST\_MBOX

An EC write to this register at offset 101h will set bit [EC\\_WR](#) in the [Interrupt Source Register](#) to '1b'. The [EC\\_WR](#) bit is routed to the Runtime Registers as the [EM\\_EVT1](#) bit. The EC can also read this register.

Writes of a 1 to any bit in this register at offset 01h, by the Host or by the EC, will cause the bit to be cleared. Writes of a 0 to any bit have no effect.

### 12.6.3 EC ADDRESS REGISTER

**TABLE 12-4: EC ADDRESS REGISTER**

<b>HOST OFFSET</b>	Byte 0: 02h Byte 1: 03h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						0000h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE1 BIT</b>	<b>D15</b>	<b>D14</b>	<b>D13</b>	<b>D12</b>	<b>D11</b>	<b>D10</b>	<b>D9</b>	<b>D8</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Region	EC_Address[14:8]							
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	EC_Address[7:2]						Access_Type		

## Access\_Type

This field defines the type of access that occurs when the [EC Data Register](#) is read or written.

00: 8-bit access. Any byte read of Byte 0 through Byte 3 in the [EC Data Register](#) causes the corresponding byte within the 32-bit double word addressed by [EC\\_Address](#) to be loaded into the byte of [EC Data Register](#) and returned by the read. Any byte write to Byte 0 through Byte 3 in the [EC Data Register](#) writes the corresponding byte within the 32-bit double word addressed by [EC\\_Address](#), as well as the byte of the [EC Data Register](#).

01: 16-bit access. A read of Byte 0 in the [EC Data Register](#) causes the 16 bits in the DCCM at an offset of [EC\\_Address](#) to be loaded into Byte 0 and Byte 1 of the [EC Data Register](#). The read then returns the contents of Byte 0. A read of Byte 2 in the [EC Data Register](#) causes the 16 bits in the DCCM at an offset of [EC\\_Address+2](#) to be loaded into Byte 2 and Byte 3 of the [EC Data Register](#). The read then returns the contents of Byte 2. A read of Byte 1 or Byte 3 in the [EC Data Register](#) return the contents of the register, without any update from the DCCM.

A write of Byte 1 in the [EC Data Register](#) causes Bytes 1 and 0 of the [EC Data Register](#) to be written into the 16 bits in the DCCM at an offset of [EC\\_Address](#). A write of Byte 3 in the [EC Data Register](#) causes Bytes 3 and 2 of the [EC Data Register](#) to be written into the 16 bits in the DCCM at an offset of [EC\\_Address+2](#). A write of Byte 0 or Byte 2 in the [EC Data Register](#) updates the contents of the register, without any change to the DCCM.

10: 32-bit access. A read of Byte 0 in the [EC Data Register](#) causes the 32 bits in the DCCM at an offset of [EC\\_Address](#) to be loaded into the entire [EC Data Register](#). The read then returns the contents of Byte 0. A read of Byte 1, Byte 2 or Byte 3 in the [EC Data Register](#) returns the contents of the register, without any update from the DCCM.

A write of Byte 3 in the [EC Data Register](#) causes the [EC Data Register](#) to be written into the 32 bits in the DCCM at an offset of [EC\\_Address](#). A write of Byte 0, Byte 1 or Byte 2 in the [EC Data Register](#) updates the contents of the register, without any change to the DCCM.

11: Auto-increment 32-bit access. This defines a 32-bit access, as in the 10 case. In addition, any read or write of Byte 3 in the [EC Data Register](#) causes the [EC Address Register](#) to be incremented by 1. That is, the [EC\\_Address](#) field will point to the next 32-bit double word in the DCCM.

## EC\_Address[14:2]

This field defines the location in memory that can be read and/or written with the [EC Data Register](#). The address is an offset from the base of the Host-accessible region in the EC DCCM SRAM. The base of the Host-accessible region.

## Region

The field specifies which of two segments in the on-chip SRAM is to be used in conjunction with [EC\\_Address\[14:2\]](#) to generate accesses to the memory.

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## 12.6.4 EC DATA REGISTER

**TABLE 12-5: EC DATA REGISTER**

<b>HOST OFFSET</b>	Byte 0: 04h Byte 1: 05h Byte 2: 06h Byte 3: 07h			8-bit			<b>HOST SIZE</b>	
<b>POWER</b>	VTR			0000_0000h			<b>VTR POR DEFAULT</b>	
<b>BYTE3 BIT</b>	<b>D31</b>	<b>D30</b>	<b>D29</b>	<b>D28</b>	<b>D27</b>	<b>D26</b>	<b>D25</b>	<b>D24</b>
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Data3[7:0]							
<b>BYTE2 BIT</b>	<b>D23</b>	<b>D22</b>	<b>D21</b>	<b>D20</b>	<b>D19</b>	<b>D18</b>	<b>D17</b>	<b>D16</b>
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Data2[7:0]							
<b>BYTE1 BIT</b>	<b>D15</b>	<b>D14</b>	<b>D13</b>	<b>D12</b>	<b>D11</b>	<b>D10</b>	<b>D9</b>	<b>D8</b>
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Data1[7:0]							
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Data0[7:0]							

## DATA

This is a 32-bit register which returns data to the Host from the EC DCCM at the address specified by [EC\\_Address\[14:2\]](#). The description of bits [Access\\_Type](#) in the [EC Address Register](#) defines which reads and writes from the Host trigger transfers of data between this register and the DCCM.

A write to the [EC Data Register](#) when the [EC Address Register](#) is in a read-only or a no-access region, as defined by the Memory Base and Limit registers, will update the [EC Data Register](#) but memory will not be modified. A read to the [EC Data Register](#) when the [EC Address Register](#) is in a no-access region, as defined by the Memory Base and Limit registers, will not trigger a memory read and will not modify the [EC Data Register](#). In auto-increment mode ([Access\\_Type=11b](#)), reads of Byte 3 of the [EC Data Register](#) will still trigger increments of the [EC Address Register](#) when the address is out of bounds, while writes of Byte 3 will not.

## 12.6.5 INTERRUPT SOURCE REGISTER

**TABLE 12-6: INTERRUPT SOURCE REGISTER**

<b>HOST OFFSET</b>	Byte 0: 08h Byte 1: 09h			8-Bit			<b>HOST SIZE</b>		
<b>POWER</b>	VTR			0000h			<b>nSYS_RST DEFAULT</b>		
<b>BYTE1 BIT</b>	<b>D15</b>	<b>D14</b>	<b>D13</b>	<b>D12</b>	<b>D11</b>	<b>D10</b>	<b>D9</b>	<b>D8</b>	
<b>TYPE</b>	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	
<b>BIT NAME</b>	EC_SWI[14:7]								
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R	
<b>BIT NAME</b>	EC_SWI[6:0]							EC_WR	

## EC\_WR

This bit is set autonomously when the [EC-to-Host Mailbox Register](#) has been written by the EC at offset 101h. This bit appears as the signal EM\_EVT1 in the Runtime Registers and can be used to enable a PME or SMI. In addition, if this bit is 1 and bit [EC\\_WR\\_EN](#) in the [Interrupt Mask Register](#) is 1, the signal EM\_EVT2 will be asserted in the Runtime Register block.

This bit is automatically cleared by a read of the [EC-to-Host Mailbox Register](#) at offset 01h.

## EC\_SWI

Each bit in this field is cleared when written with a '1b'. The ability to clear the bit can be disabled by the EC.

The signal EM\_EVT2 will be asserted in the Runtime Register block if any bit in this field is 1 and the corresponding bit in the [EC\\_SWI\\_EN](#) field in the [Interrupt Mask Register](#) is also 1.

### 12.6.6 INTERRUPT MASK REGISTER

**TABLE 12-7: INTERRUPT MASK REGISTER**

HOST OFFSET	Byte 0: 0Ah Byte 1: 0Bh						8-Bit	HOST SIZE	
POWER	VTR						0000h	nSYS_RST DEFAULT	
BYTE1 BIT	D15	D14	D13	D12	D11	D10	D9	D8	
TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
BIT NAME	EC_SWI_EN[14:7]								
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
BIT NAME	EC_SWI_EN[6:0]							EC_WR_EN	

## EC\_WR\_EN

If this bit is '1b', the interrupt generated by bit [EC\\_WR](#) in the [Interrupt Source Register](#) is enabled.

## EC\_SWI\_EN

Each bit that is set to '1b' in this field enables the generation of and interrupt by the corresponding bit in the [EC\\_SWI](#) field in the [Interrupt Source Register](#).

### 12.6.7 APPLICATION ID REGISTER

**TABLE 12-8: APPLICATION ID REGISTER**

HOST OFFSET	0Ch						8-Bit	HOST SIZE	
POWER	VTR						00h	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
BIT NAME	Application_ID[7:0]								

## Application\_ID

When this field is 00h it can be written with any value. When set to a non-zero value, writing that value will clear this register to 00h. When set to a non-zero value, writing any value other than the current contents will have no effect.

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## 13.0 PME SUPPORT

The SCH5627P offers support for power management events (PMEs), also referred to as a System Control Interrupt (SCI) events in an ACPI system. A power management event is indicated to the chipset via the assertion of the IO\_PME# signal and functions as a wake event (that is, a PME can wake a system that is in a sleep state). In the SCH5627P, the IO\_PME# is asserted by active transitions on the ring indicator inputs RI1# and RI2#, active keyboard-data edges, active mouse-data edges, programmable edges on GPIO pins and temperature events. The GP041/IO\_PME# pin, when selected for the IO\_PME# function, can be programmed to be active high or active low via the polarity bit in the GP041 Pin Control register. The output buffer type of the pin can also be programmed to be open-drain or push-pull.

PMEs can also be enabled onto the Serial IRQ stream, by configuring a SERIRQ channel for the Runtime Registers Logical Device, with the SELECT function set to 0. See [Section 7.6, "SERIRQ Interrupts"](#).

**Note:** If the host enables UART2 and requires the RI2# pin for wakeup, the host should configure the Pin Control register for GP062/RI2# so that the Mux Control field selects RI2# and the Interrupt Detection selects falling edge. If the host enables UART1 and requires the RI1# pin for wakeup, the host should configure the Pin Control register for GP052/RI1# so that the Mux Control field selects RI1# and the Interrupt Detection selects falling edge.

The PME functionality is controlled by the [PME\\_STS Register](#) and the [PME\\_EN Register](#) in the Runtime Registers block, in Logical Device A. The PME Enable bit, PME\_EN, globally controls PME Wake-up events. When PME\_EN is inactive, the IO\_PME# signal can not be asserted. When PME\_EN is asserted, any wake source whose individual PME Wake Enable register bit is asserted can cause IO\_PME# to become asserted.

The PME Status register indicates that an enabled wake source has occurred, and if the PME\_EN bit is set, asserted the IO\_PME# signal. The PME Status bit is asserted by when any PME Status bit is asserted. PME Status registers are described in [Section 16.0, "Runtime Registers"](#), which defines whether PME Status bits are set on edge events or level events. The PME\_Status bit in the [PME\\_STS Register](#) will become asserted independent of the state of the global PME enable bit, PME\_EN.

The following pertains to the PME status bits for each event:

- The output of the status bit for each event is combined with the corresponding enable bit to set the PME status bit.
- The status bit for any pending events must be cleared in order to clear the PME\_STS bit. Status bits are cleared on a write of '1'. Read-only status bits must be cleared at their source.

See [Section 8.5.8, "Keyboard and Mouse PME Generation"](#) in [Section 8.0, "Keyboard Controller"](#) for information about using the keyboard and mouse signals to generate a PME.

The PME registers are located in system I/O space at an offset from the Base Address programmed for Logical Device Ah.

See PME register descriptions in [Section 16.0, "Runtime Registers"](#).

### 13.1 GPIO Events

Eight GPIO pins can be used to generate Power Management Events. For GPIO events, the polarity of the edge used to set the status bit and generate a PME is controlled by the Interrupt Detection field in the Pin Control register associated with the GPIO. These GPIOs will only generate a PME if the Interrupt Detection field is configured for edge-sensitive interrupts. If the GPIO is configured for a level-sensitive interrupt, or edge detection is disabled, then the GPIO cannot generate a PME. Status bits are cleared on a write of '1'. These eight GPIOs can also be used to generate System Management Interrupts.

### 13.2 Enabling SMI Events onto the PME Pin

There is a bit in the [PME\\_STS2 Register](#) to show the status of the internal "group" SMI signal in the PME logic (if bit 5 of the [SMI\\_EN2 Register](#) is set). This bit, [Devint\\_Status](#), is at bit 0 of the [PME\\_STS2 Register](#) register. This bit is defined as follows:

0= The group SMI output is inactive.

1= The group SMI output is active.

[Devint\\_Status](#), when asserted, can generate a PME if the [Devint\\_Status Enable](#) bit in [PME\\_EN2 Register](#) is 1.



## 13.3 Low Battery Warning PME Event

See [Section 15.0, "Low Battery Detection," on page 147](#) for a description of Low Battery PME events.

The Low\_Bat PME event is indicated and enabled via the [PME\\_STS2 Register](#) and the [PME\\_EN2 Register](#). See [Section 16.0, "Runtime Registers," on page 149](#) for a description of these registers.

## 13.4 "Wake on Specific Key" Event

See [Section 8.6, "Wake on Specific Key' Option," on page 60](#) in [Section 8.0, "Keyboard Controller"](#) for a description of this event.

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## 14.0 SMI SUPPORT

The SCH5627P implements a “group” IO\_SMI# output pin. The System Management Interrupt is a non-maskable interrupt with the highest priority level used for OS transparent power management. The SMI group interrupt output consists of the enabled interrupts from each of the functional blocks in the chip and several of the GPIOs and the temperature monitoring. The GP071/IO\_SMI# pin, when selected for the IO\_SMI# function, can be programmed to be active high or active low via the polarity bit in the GP071 pin control register. The output buffer type of the pin can also be programmed to be open-drain or push-pull via the pin control register.

The interrupts are enabled onto the group SMI# signal as defined in the description of the [SMI\\_STS Register](#). The group SMI# signal is then enabled onto the IO\_SMI# output pin via bit[7] in the SMI Enable Register 2. The group SMI# signal can also be enabled onto the serial IRQ stream via Bit[6] in the SMI Enable Register 2. The configuration logic for SER\_IRQ can route the SMI# signal onto any SERIRQ channel. In addition, the internal SMI can be enabled onto the IO\_PME# pin. Bit[5] of the SMI Enable Register 2 is used to enable the SMI output onto the IO\_PME# pin (GP041). This bit will enable the internal SMI output into the PME logic through the DEVINT\_STS bit in PME\_STS3. See [Section 13.0, "PME Support," on page 144](#) for more details.

### 14.1 SMI Registers

The event bits for generating System Management Interrupts are located in the SMI Status and Enable registers. The SMI logic for these events is implemented such that the output of the status bit for each event is combined with the corresponding enable bit in order to generate an SMI.

The SMI registers are accessed at an offset from the base I/O address for logical device A (see [Section 16.0, "Runtime Registers," on page 149](#) for more information).

Status bits for events for super I/O devices are located in the [SMI\\_STS1 Register](#) and the [SMI\\_STS2 Register](#). All of these status bits are cleared at the source. The SMI logic for these events is implemented such that each event is directly combined with the corresponding enable bit in order to generate an SMI.

SMI events for Low Bat, the EC Watchdog Timer and the GPIO events must be cleared in the SMI Status registers.

[SMI\\_EN2 Register](#) also contains the bit to enable the group SMI onto the IO\_SMI# output pin via (bit[7]), the bit to enable the group SMI onto the serial IRQ stream (Bit[6]) and the bit to enable the group SMI signal onto the IO\_PME# pin (Bit[5]).

### 14.2 GPIO SMI Events

Eight GPIO pins can be used to generate SMI events. For GPIO events, the polarity of the edge used to set the status bit and generate an SMI is controlled by the Interrupt Detection field in the Pin Control register associated with the GPIO. These GPIOs will only generate an SMI if the Interrupt Detection field is configured for edge-sensitive interrupts. If the GPIO is configured for a level-sensitive interrupt, or edge detection is disabled, then the GPIO cannot generate a SMI. These same eight GPIOs can also be used to generate Power Management Events.

### 14.3 Low Battery Warning SMI Event

See [Section 15.0, "Low Battery Detection," on page 147](#) for a description of Low Battery SMI events.

The Low\_Bat SMI event is indicated and enabled via the [SMI\\_STS2 Register](#) and the [SMI\\_EN2 Register](#). See [Section 16.0, "Runtime Registers," on page 149](#) for a description of these registers.

## 15.0 LOW BATTERY DETECTION

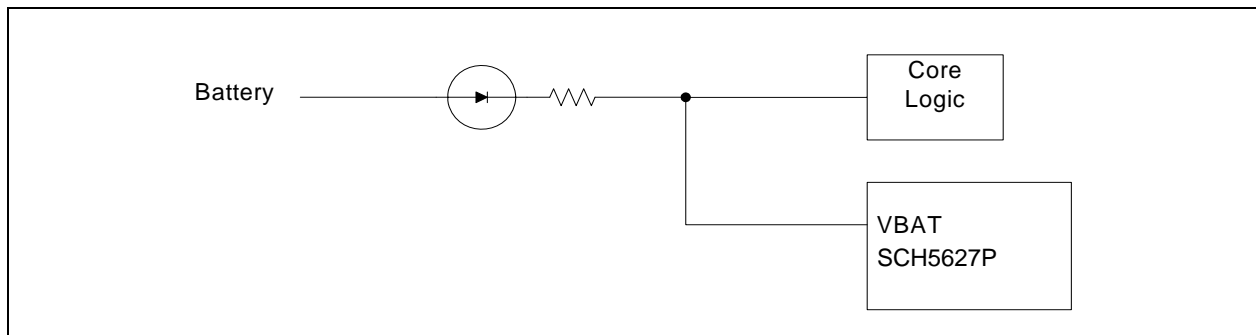
The SCH5627P can be used with an external battery to provide battery backup for the [VBAT Powered RAM](#) as well as several internal status bits. The status of the battery voltage is checked at three different times by the SCH5627P

- When the battery is replaced while VTR power is off
- On the rising edge of VTR
- On the rising edge of VCC

Two state bits in Runtime space, [Low\\_Bat](#) in the [PME\\_STS2 Register](#) and [Low\\_Bat](#) in the [SMI\\_STS2 Register](#), track the status of the external battery. These bits can be accessed by the Host and used to generate Host events.

Figure 15-1, "External Battery Circuit", illustrates the external battery circuit:

**FIGURE 15-1: EXTERNAL BATTERY CIRCUIT**



The battery voltage measured at the VBAT pin, not at the source, so battery voltages described in this chapter incorporate the approximate 0.3V voltage drop caused by the diode in the figure.

### 15.1 Battery Voltage Detection

Battery voltage is monitored in the three conditions defined in the following sections:

#### 15.1.1 VTR POWER OFF

If, while the VTR power supply is off, the external battery is removed and replaced with a battery that delivers at least approximately 1.2V, a VBAT Power On Reset (VBAT POR) is signaled. A VBAT POR will cause the internal battery-backed status bits to their default state. The VBAT Powered RAM is not reset, however, a VBAT POR indicates that the contents of the VBAT Powered RAM are indeterminate. A VBAT POR sets an internal state bit that is readable and clearable by the EC.

Removing and replacing the external battery has no effect if VTR power is on.

#### 15.1.2 RISING EDGE OF VTR

When VTR rises above its operational threshold, the battery voltage is checked to see if it is less than approximately 1.2V. If the battery voltage is below the 1.2V threshold, the internal VBAT POR state is set; If the battery voltage is above the 1.2V threshold, the internal VBAT POR state is not modified.

#### 15.1.3 RISING EDGE OF VCC

When VCC rises above its operational threshold, the VBAT pin is measured and compared to a threshold of approximately 2.2V. This threshold is only checked on the rising edge of VCC.

## 15.2 Low Battery Events

Both the Power Management Event logic and the System Management Interrupt logic have state bits that report the status of VBAT voltage. These bits are [Low\\_Bat](#) in the [PME\\_STS2 Register](#) and [Low\\_Bat](#) in the [SMI\\_STS2 Register](#). On the rising edge of VTR, these two bits are both initialized to '1' if either the battery was replaced while VTR was off, or the battery was below threshold when VTR reached its operational threshold. In addition, both bits are set to '1' if the battery voltage is below approximately 2.2V when VCC rises above its operational threshold. Neither Low\_Bat bit is modified if the battery voltage is above approximately 2.2V when VCC rises.

Both Low\_Bat status bits can only be cleared when written with a '1' by software.

Since the PME enable bit is not battery backed up and is cleared on VTR POR, the Low\_Bat PME status bit is not normally a wakeup event since it cannot be enabled when VTR is on but VCC is off. When VCC returns, if the PME or SMI enable bit (and other associated enable bits) are set while the respective Low\_Bat bits are '1', then the corresponding event will be generated.

Both the PME and SMI Low\_Bat status bits can be enabled while VCC is active. No event will be generated if neither status bit is set when enabled. If VCC goes away, the Low\_Bat enable bits will remain active, but no event will be triggered because neither Low\_Bat status bit can be triggered while operating on VTR power alone. When VCC returns, if the PME or SMI enable bit (and other associated enable bits) are set and the battery voltage is below approximately 2.2V, then a corresponding event will be generated.

## 15.3 Synchronization with the EC

The EC maintains the internal battery-back status bits that are used to configure the Low\_Bat status bits in the PME and SMI status registers. This status bit retains its value across VTR power cycles, so that the EC and the Host can properly service battery events even if VTR power goes down after a low voltage event but before the EC or the Host can react to the event. In order to insure that the EC and the Host are in synch with respect to processing low voltage events, the Host should inform the EC that it has processed the Low\_Bat events in the PME and SMI status registers.

## 16.0 RUNTIME REGISTERS

### 16.1 Power, Clocks and Reset

#### 16.1.1 RESET

This block is reset when nSYS\_RST is asserted. The [Force Disk Change Register](#) is also reset on nSIO\_RESET.

### 16.2 Interrupts

#### 16.2.1 HOST INTERRUPTS

The PME\_STS/PME\_EN registers can assert the IO\_PME# pin and thus can be used to generate a PME to the Host. The SMI\_STS/SMI\_EN registers can assert the IO\_SMI# pin and can be used to generate an SMI to the Host. The PME can also be routed to a SERIRQ channel in the LPC Configuration block, as the first of the two interrupts from the Runtime Register block (SELECT=0). The SMI can be routed to the SERIRQ as the second interrupt from the Runtime Register block (SELECT=1).

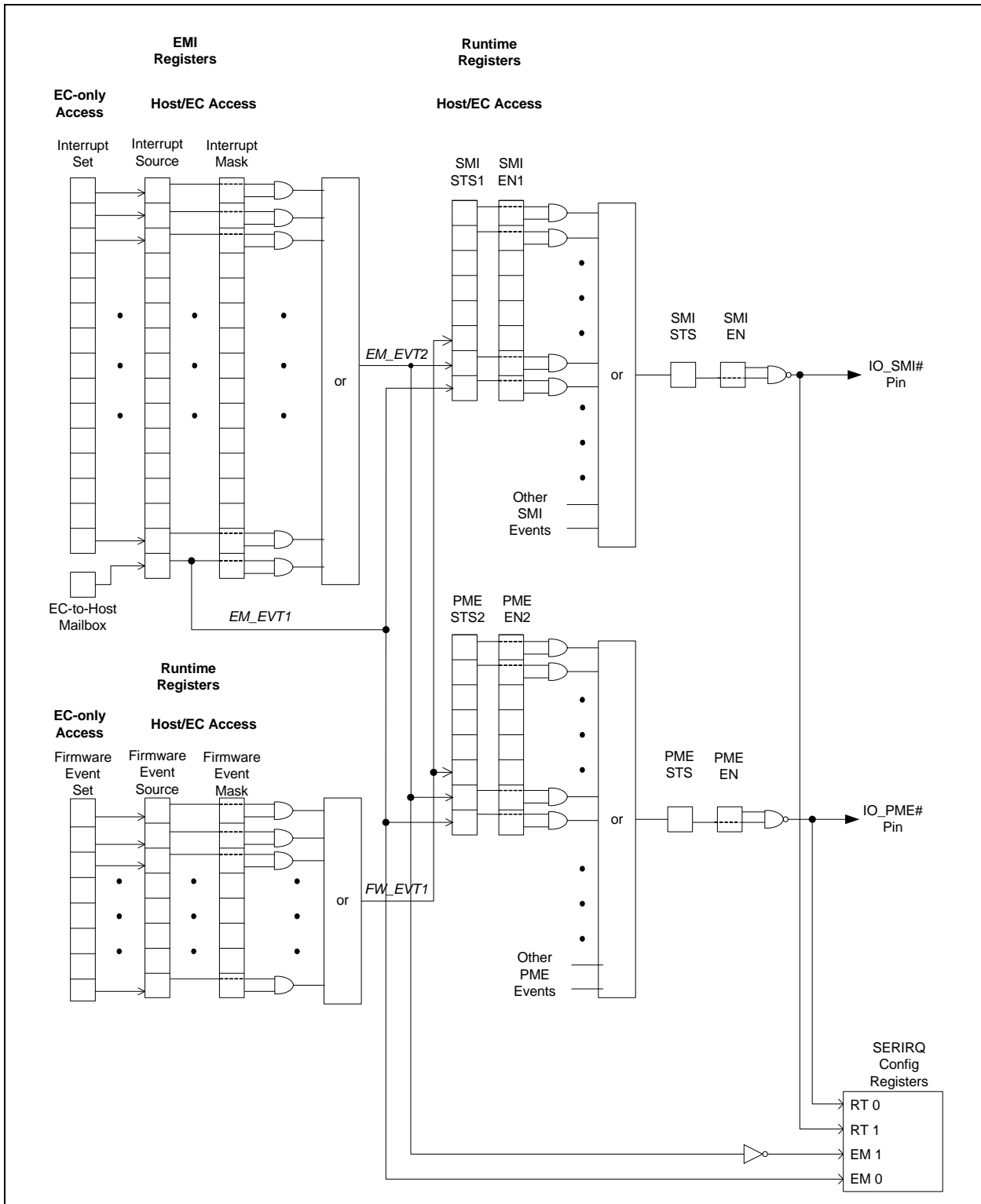
The SMI event produces a standard active low on the serial IRQ stream, and active low on the open drain IO\_SMI# pin. The PME event also produces a standard active low on the serial IRQ stream, and active low on the open drain IO\_PME# pin.

Firmware can generate a PME or an SMI through three EVT event bits. The EMI generates the EM\_EVT1 and EM\_EVT2 signals, and the [Firmware Event Status Register/Firmware Event Enable Register](#) pair generates the FW\_EVT3 signal. The three EVT signals are routed to both the PME generation logic (in [PME\\_STS2 Register](#)) and the SMI generation logic (in [SMI\\_STS1 Register](#)).

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The event signal routing is illustrated in Figure 16-1, "SMI/PME Interrupt Routing":

**FIGURE 16-1: SMI/PME INTERRUPT ROUTING**



**Note:** Unless noted, all PME and SMI status bits are level-sensitive.

## 16.3 Registers

Table 16-1 is a register summary for the [Runtime Registers](#). The LPC I/O address for each Run-Time Register is described below as an offset from the Base Address Register. Each Configuration register access through the [Host Access Port](#) is via its LDN indicated in [Table 4-1, "Host Logical Devices on SCH5627P," on page 26](#) and its [Host Access Port](#) index which is described as "Host Config Index" in the tables below.

**TABLE 16-1: RUNTIME REGISTERS REGISTER SUMMARY**

Register Name	I/O Offset	Size	Type	Notes
<b>RUNTIME REGISTERS</b>				
<a href="#">PME_STS Register</a>	00h	8	R/WC	
<a href="#">PME_EN Register</a>	01h	8	R/W	
<a href="#">PME_STS1 Register</a>	02h	8	R/WC	
<a href="#">PME_STS2 Register</a>	03h	8	R/WC	
<a href="#">PME_STS3 Register</a>	04h	8	R/WC	
<a href="#">PME_EN1 Register</a>	05h	8	R/W	
<a href="#">PME_EN2 Register</a>	06h	8	R/W	
<a href="#">PME_EN3 Register</a>	07h	8	R/W	
<a href="#">SMI_STS Register</a>	10h	8	R/WC	
<a href="#">SMI_EN Register</a>	11h	8	R/W	
<a href="#">SMI_STS1 Register</a>	12h	8	R/WC	
<a href="#">SMI_STS2 Register</a>	13h	8	R/WC	
<a href="#">SMI_STS3 Register</a>	14h	8	R/WC	
<a href="#">SMI_EN1 Register</a>	15h	8	R/W	
<a href="#">SMI_EN2 Register</a>	16h	8	R/W	
<a href="#">SMI_EN3 Register</a>	17h	8	R/W	
<a href="#">Force Disk Change Register</a>	20h	8	R/W	
<a href="#">Floppy Data Rate Select Shadow Register</a>	21h	8	R	
<a href="#">UART 1 FIFO Control Shadow Register</a>	22h	8	R	
<a href="#">UART 2 FIFO Control Shadow Register</a>	23h	8	R	
<a href="#">Device Disable Register</a>	24h	8	R/W	
<a href="#">LED Register</a>	25h	8	R/W	
<a href="#">Keyboard Scan Register</a>	26h	8	R/W	
<a href="#">Power Good Register</a>	27h	8	R/W	
<a href="#">GPIO Select Register</a>	28h	8	R/W	
<a href="#">GPIO Read Register</a>	29h	8	R/W	
<a href="#">Firmware Event Status Register</a>	30h	8	R/WC	
<a href="#">Firmware Event Enable Register</a>	31h	8	R/W	
<a href="#">Power Recovery Modes Register</a>	32h	8	R/W	
<a href="#">Intruder Register</a> <a href="#">Intruder Register</a>	34h	8	R/W	
<b>CONFIGURATION REGISTERS</b>				
<a href="#">SPEKEY</a>	F0h	8	R/W	<a href="#">Note 16-1</a>

**Note 16-1** See [Section 8.6, "'Wake on Specific Key' Option," on page 60](#).

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## 16.3.1 PME\_STS REGISTER

**TABLE 16-2: PME\_STS REGISTER**

<b>HOST OFFSET</b>	00h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R/WC	
<b>BIT NAME</b>	Reserved							PME_Status	

### PME\_Status

PME Status. This bit is set to 1 if any bit in a `PME_STSi` register is a 1 and enabled by the corresponding bit in the `PME_ENi` register. If this bit is a 1 and `PME_Enable` in the `PME_EN Register` is a 1, the `IO_PME#` signal will be asserted. This bit is cleared by writing it with a 1. Writing a 0 to this bit has no effect.

0= No PME event (default)

1= PME Event active.

## 16.3.2 PME\_EN REGISTER

**TABLE 16-3: PME\_EN REGISTER**

<b>HOST OFFSET</b>	01h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R/W	
<b>BIT NAME</b>	Reserved							PME_Enable	

### PME\_Enable

PME Enable. This bit enables assertion of the `IO_PME#` pin.

0= `IO_PME#` signal assertion is disabled (default)

1= Enables assertion of the `IO_PME#` signal

## 16.3.3 PME\_STS1 REGISTER

PME Wake Status 1 register. The `PME_Status` bit is asserted if any bit in this register is 1 and the corresponding bit in the `PME_EN1 Register` is also 1. All bits are cleared by writing with a 1. Writes of a 0 to any bit have no effect.

Wake events are events that can wake up the host if it is in a sleep state.

All status bits in this register are set on signal edges.

**TABLE 16-4: PME\_STS1 REGISTER**

<b>HOST OFFSET</b>	02h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R/WC	R/WC	R/WC	R/WC	R/WC	R	
<b>BIT NAME</b>	Reserved		SPEKEY	MOUSE	KBD	RI1	RI2	Reserved	



## RI2

This bit is set to 1 if the Ring Indicator Wake event from UART 2 is asserted. The wake event is asserted on the falling edge of the RI2# pin.

**Note:** In order to generate an RI2 event, the Interrupt Detection field in the Pin Control register for GP062, the GPIO associated with RI2# as an alternate function, must be configured for falling edge interrupts.

## RI1

This bit is set to 1 if the Ring Indicator Wake event from UART 1 is asserted. The wake event is asserted on the falling edge of the RI1# pin.

**Note:** In order to generate an RI1 event, the Interrupt Detection field in the Pin Control register for GP052, the GPIO associated with RI1# as an alternate function, must be configured for falling edge interrupts.

## KBD

This bit is set to 1 if the KBD Wake event from the Keyboard PS/2 is asserted. The wake event is asserted on the falling edge of the KDAT pin.

## MOUSE

This bit is set to 1 if the Mouse Wake event from the Mouse PS/2 is asserted. The wake event is asserted on the falling edge of the MDAT pin.

## SPEKEY

This bit is set to 1 if the wake on specific key wake event is asserted.

### 16.3.4 PME\_STS2 REGISTER

PME Wake Status 2 register. All bits are cleared by writing with a 1. Writes of a 0 to any bit have no effect.

**TABLE 16-5: PME\_STS2 REGISTER**

HOST OFFSET	03h						8-bit	HOST SIZE	
POWER	VTR			0XX0_0000b			DEFAULT		
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R	R	R/WC	R	R	R	R/WC	R/WC	
BIT NAME	Reserved	Intrusion	Low_Bat	FW_EVT1	EM_EVT2	EM_EVT1	WDT	Devint_Status	

### Devint\_Status

This bit is set to 1 if the IO\_SMI# signal is asserted by the SMI logic.

### WDT

This bit is set to 1 if a Watchdog Timer event is asserted when the watchdog times out.

### EM\_EVT1

This bit is set to 1 if the EC\_WR bit (bit 0) of the Interrupt Source Register in the EM Interface is asserted.

### EM\_EVT2

This bit is set to 1 if any of the 16 bits in the Interrupt Source Register in the EM Interface is asserted and enabled by the corresponding bit in the Interrupt Enable Register in the EM Interface.

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## FW\_EVT1

This bit is set to 1 if any of the bits in the [Firmware Event Status Register](#) in the Runtime Register block is asserted and enabled by the corresponding bit in the [Firmware Event Enable Register](#).

## Low\_Bat

When VTR reaches the its operating threshold, Low\_Bat is set to the value of the [VBAT\\_POR](#) bit in the battery-backed internal status register. When VCC RESET is de-asserted, this bit is also set to 1 if the [VBAT\\_Low](#) bit in the battery-backed internal status register is asserted and not modified otherwise. The low battery event will not normally be a PME wakeup event because the Low\_Bat Enable bit will be cleared on VTR POR, when Low\_Bat is set. See [Section 15.0, "Low Battery Detection," on page 147](#) for more details on the battery monitoring logic.

## Intrusion

This bit is a copy of [INTRUSION](#) in the [Intruder Register](#) and follows its behavior. If enabled, a PME is generated when [INTRUSION](#) is high. [INTRUSION](#) in the [Intruder Register](#) must be cleared in order for this bit to be cleared.

### 16.3.5 PME\_STS3 REGISTER

PME Wake Status 3 register. All bits are cleared by writing with a 1. Writes of a 0 to any bit have no effect.

For each GPIO monitored by this register, a PME is asserted if the GPIO pin value changes according to the [Interrupt Detection](#) field in the [Pin Control Register](#) associated with the GPIO. PME events are only asserted if the [Interrupt Detection](#) field is set to an edge-triggered events. If the field is set to a level-sensitive event, no PME will be generated even if the pin matches the selected level.

**Note:** If the [Interrupt Detection](#) field for one of the GPIO pins monitored by this register is changed from no-edge-detection to edge-triggered interrupts while the pin is high, the status bit will be set. Host software should clear the GPIO status bit in this register whenever it reconfigures the [Interrupt Detection](#) field in the [Pin Control Register](#) for the GPIO, in order to avoid a spurious event.

**TABLE 16-6: PME\_STS3 REGISTER**

HOST OFFSET	04h			8-bit			HOST SIZE	
POWER	VTR			00h			nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
TYPE	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC
BIT NAME	GPIO62	GPIO54	GPIO53	GPIO35	GPIO31	GPIO25	GPIO24	GPIO21

## GPIO21

This bit is set to 1 if a wake event for GPIO21 is asserted.

## GPIO24

This bit is set to 1 if a wake event for GPIO24 is asserted.

## GPIO25

This bit is set to 1 if a wake event for GPIO25 is asserted.

## GPIO31

bit This bit is set to 1 if a wake event for GPIO31 is asserted.

## GPIO35

This bit is set to 1 if a wake event for GPIO35 is asserted.

## GPIO53

This bit is set to 1 if a wake event for GPIO53 is asserted.

## GPIO54

This bit is set to 1 if a wake event for GPIO54 is asserted.

## GPIO62

This bit is set to 1 if a wake event for GPIO62 is asserted.

### 16.3.6 PME\_EN1 REGISTER

PME Wake Enable 1 register. This register is used to enable individual PME wake sources from the [PME\\_STS1 Register](#) onto the [PME\\_Status](#) bit in the [PME\\_STS Register](#). Bit fields correspond to the fields in the [PME\\_STS1 Register](#).

**TABLE 16-7: PME\_EN1 REGISTER**

<b>HOST OFFSET</b>	05h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R/W	R/W	R/W	R/W	R/W	R	
<b>BIT NAME</b>	Reserved		SPEKEY	MOUSE	KBD	RI1	RI2	Reserved	

### 16.3.7 PME\_EN2 REGISTER

PME Wake Enable 1 register. This register is used to enable individual PME wake sources from the [PME\\_STS2 Register](#) onto the [PME\\_Status](#) bit in the [PME\\_STS Register](#). Bit fields correspond to the fields in the [PME\\_STS2 Register](#).

**TABLE 16-8: PME\_EN2 REGISTER**

<b>HOST OFFSET</b>	06h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Reserved	Intrusion	Low_Bat	FW_EVT1	EM_EVT2	EM_EVT1	WDT	Devint_Status	

### 16.3.8 PME\_EN3 REGISTER

PME Wake Enable 1 register. This register is used to enable individual PME wake sources from the [PME\\_STS3 Register](#) onto the [PME\\_Status](#) bit in the [PME\\_STS Register](#). Bit fields correspond to the fields in the [PME\\_STS3 Register](#).

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**TABLE 16-9: PME\_EN3 REGISTER**

<b>HOST OFFSET</b>	07h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	GPIO62	GPIO54	GPIO53	GPIO35	GPIO31	GPIO25	GPIO24	GPIO21	

## 16.3.9 SMI\_STS REGISTER

**TABLE 16-10: SMI\_STS REGISTER**

<b>HOST OFFSET</b>	10h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R/WC	
<b>BIT NAME</b>	Reserved							SMI_Status	

### SMI\_Status

SMI Status. This bit is set to 1 if any bit in a SMI\_STS*i* register is a 1 and enabled by the corresponding bit in the SMI\_EN*i* register. If this bit is a 1 and SMI\_Enable in the SMI\_EN Register is a 1, an SMI will be asserted. An SMI will be asserted on the IO\_SMI# pin, on the SERIRQ, or in the Devint\_Status bit in the PME\_STS2 Register, according to the respective enable bits in the SMI\_EN2 Register. This bit is cleared by writing it with a 1. Writing a 0 to this bit has no effect.

0= No SMI event (default)

1= SMI Event active.

## 16.3.10 SMI\_EN REGISTER

**TABLE 16-11: SMI\_EN REGISTER**

<b>HOST OFFSET</b>	11h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R/W	
<b>BIT NAME</b>	Reserved							SMI_Enable	

### SMI\_Enable

This bit enables assertion of the SMI function.

0= SMI function assertion is disabled (default)

1= Enables assertion of the SMI function

## 16.3.11 SMI\_STS1 REGISTER

SMI Status 1 register. The IO\_SMI# pin is asserted if any bit in this register is 1 and the corresponding bit in is also 1. All bits must be cleared at the source except as shown.

**TABLE 16-12: SMI\_STS1 REGISTER**

HOST OFFSET	12h			8-bit			HOST SIZE	
POWER	VTR			0000_001Xb			nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
TYPE	R	R	R	R	R	R	R	R/WC
BIT NAME	FW_ EVT1	EM_ EVT2	EM_ EVT1	FINT	U1INT	U2INT	PINT	Low_ Bat

### Low\_Bat

When VTR reaches the its operating threshold, Low\_Bat is set to the value of the [VBAT\\_POR](#) bit in the battery-backed internal status register. When VCC RESET is de-asserted, this bit is also set to 1 if the [VBAT\\_Low](#) bit in the battery-backed internal status register is asserted and not modified otherwise.

In normal use, the low battery event is not a PME wakeup event because the Low\_Bat Enable bit will be cleared on VTR POR, when Low\_Bat is set.

See [Section 15.0, "Low Battery Detection," on page 147](#) for more details on the battery monitoring logic.

### PINT

The parallel port interrupt defaults to '1b' when the parallel port activate bit is cleared. When the parallel port is activated, PINT follows the ACK# input.

### U2INT

This bit follows the interrupt bit from UART 2.

### UINT1

This bit follows the interrupt bit from UART 1.

### FINT

This bit follows the interrupt bit from Floppy Disk Controller.

### EM\_EVT1

This bit is set to 1 if the EC\_WR bit (bit 0) of the Interrupt Source Register in the EM Interface is asserted.

### EM\_EVT2

This bit is set to 1 if any of the 16 bits in the Interrupt Source Register in the EM Interface is asserted and enabled by the corresponding bit in the Interrupt Enable Register in the EM Interface.

### FW\_EVT1

This bit is set to 1 if any of the bits in the [Firmware Event Status Register](#) in the Runtime Register block is asserted and enabled by the corresponding bit in the [Firmware Event Enable Register](#).

## 16.3.12 SMI\_STS2 REGISTER

SMI Status 2 register. The IO\_SMI# pin is asserted if any bit in this register is 1 and the corresponding bit in the [SMI\\_EN2 Register](#) is also 1. All bits must be cleared at the source unless otherwise noted.

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**TABLE 16-13: SMI\_STS2 REGISTER**

<b>HOST OFFSET</b>	13h			8-bit			<b>HOST SIZE</b>	
<b>POWER</b>	VTR			000X01XXb			<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>TYPE</b>	R	R	R	R	R/WC	R	R	R
<b>BIT NAME</b>	Reserved			Intrusion	WDT	Reserved (Note 16-2)	KINT	MINT

## MINT

This bit follows the interrupt bit from Mouse port of the 8042 Logical Device.

## KINT

This bit follows the interrupt bit from Keyboard port of the 8042 Logical Device.

## WDT

This bit is set to 1 if a Watchdog Timer event is asserted when the watchdog times out.

This bit is cleared by a write of '1b'. Writes of '0b' have no effect.

## Intrusion

This bit is a copy of **INTRUSION** in the **Intruder Register** and follows its behavior. If enabled, an SMI is generated when **INTRUSION** is high. **INTRUSION** in the **Intruder Register** must be cleared in order for this bit to be cleared.

**Note 16-2** This bit is reserved. Writes are ignored. Reads always return '1'.

### 16.3.13 SMI\_STS3 REGISTER

SMI Status 3 register. All bits are cleared by writing with a 1. Writes of a 0 to any bit have no effect.

For each GPIO monitored by this register, a SMI is asserted if the GPIO pin value changes according to the **Interrupt Detection** field in the **Pin Control Register** associated with the GPIO. SMI events are only asserted if the **Interrupt Detection** field is set to an edge-triggered events. If the field is set to a level-sensitive event, no SMI will be generated even if the pin matches the selected level.

**Note:** If the **Interrupt Detection** field for one of the GPIO pins monitored by this register is changed from no-edge-detection to edge-triggered interrupts while the pin is high, the status bit will be set. Host software should clear the GPIO status bit in this register whenever it reconfigures the **Interrupt Detection** field in the **Pin Control Register** for the GPIO, in order to avoid a spurious event.

**TABLE 16-14: SMI\_STS3 REGISTER**

<b>HOST OFFSET</b>	14h			8-bit			<b>HOST SIZE</b>	
<b>POWER</b>	VTR			00h			<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>TYPE</b>	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC
<b>BIT NAME</b>	GPIO62	GPIO54	GPIO53	GPIO35	GPIO31	GPIO25	GPIO24	GPIO21

## GPIO21

This bit is set to 1 if a wake event for GPIO21 is asserted.

## GPIO24

This bit is set to 1 if a wake event for GPIO24 is asserted.

## GPIO25

This bit is set to 1 if a wake event for GPIO25 is asserted.

## GPIO31

This bit is set to 1 if a wake event for GPIO31 is asserted.

## GPIO35

This bit is set to 1 if a wake event for GPIO35 is asserted.

## GPIO53

This bit is set to 1 if a wake event for GPIO53 is asserted.

## GPIO54

This bit is set to 1 if a wake event for GPIO54 is asserted.

## GPIO62

This bit is set to 1 if a wake event for GPIO62 is asserted.

### 16.3.14 SMI\_EN1 REGISTER

SMI Enable 1 register. This register is used to enable individual SMI sources from the [SMI\\_STS1 Register](#) onto the IO\_SMI# pin. Bit fields correspond to the fields in the [SMI\\_STS1 Register](#).

**TABLE 16-15: SMI\_EN1 REGISTER**

HOST OFFSET	15h						8-bit	HOST SIZE	
POWER	VTR						00h	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
BIT NAME	FW_ EVT1	EM_ EVT2	EM_ EVT1	FINT	U1INT	U2INT	PINT	Low_ Bat	

### 16.3.15 SMI\_EN2 REGISTER

SMI Enable 2 register. This register is used to enable individual SMI sources from the [SMI\\_STS2 Register](#) onto the IO\_SMI# pin. Bit fields correspond to the fields in the [SMI\\_STS2 Register](#) except as noted.

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**TABLE 16-16: SMI\_EN2 REGISTER**

<b>HOST OFFSET</b>	16h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R	R/W	R/W	
<b>BIT NAME</b>	EN_SMI_ PIN	EN_SMI_ S	EN_SMI_ PME	Intrusion	WDT	Reserved	KINT	MINT	

## EN\_SMI\_PME

If this bit is 1, the [Devint\\_Status](#) bit in [PME\\_STS2 Register](#) is asserted if the SMI logic asserts the SMI function (the [SMI\\_Status](#) bit in the [SMI\\_STS Register](#) is 1 and the [SMI\\_Enable](#) bit in the [SMI\\_EN Register](#) is 1).

## EN\_SMI\_S

If this bit is 1, the SMI logic is enabled onto serial IRQ if the SMI logic asserts the SMI function (the [SMI\\_Status](#) bit in the [SMI\\_STS Register](#) is 1 and the [SMI\\_Enable](#) bit in the [SMI\\_EN Register](#) is 1).

## EN\_SMI\_PIN

If this bit is 1, the SMI logic is enabled onto the IO\_SMI# pin if the SMI logic asserts the SMI function (the [SMI\\_Status](#) bit in the [SMI\\_STS Register](#) is 1 and the [SMI\\_Enable](#) bit in the [SMI\\_EN Register](#) is 1).

### 16.3.16 SMI\_EN3 REGISTER

SMI Enable 3 register. This register is used to enable individual SMI sources from the [SMI\\_STS3 Register](#) onto the IO\_SMI# pin. Bit fields correspond to the fields in the [SMI\\_STS3 Register](#).

**TABLE 16-17: SMI\_EN3 REGISTER**

<b>HOST OFFSET</b>	17h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	GPIO62	GPIO54	GPIO53	GPIO35	GPIO31	GPIO25	GPIO24	GPIO21	

### 16.3.17 FORCE DISK CHANGE REGISTER

**TABLE 16-18: FORCE DISK CHANGE REGISTER**

<b>HOST OFFSET</b>	20h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						03h	<b>nSYS_RST DEFAULT</b>	
							03h	<b>nSIO_RESET DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R/WS	
<b>BIT NAME</b>	Reserved							FDC0	



## FDC0

Force Disk Change for FDC0. Setting this bit to '1b' forces the FDD DSKCHG# input active when drive 0 has been selected. This field can be written to a 1, but cannot be cleared by software. This bit is cleared on STEP# and DS0#.

0= Inactive

1= Active

**Note 1:** DSKCHG (FDC DIR Register, bit 7) = (DS0# AND FDC0) OR DSKCHG#.

**2:** This register is reset on VTR POR, VCC RESET and PCIRESET.

### 16.3.18 FLOPPY DATA RATE SELECT SHADOW REGISTER

This register is a readable copy of the write-only Floppy Data Rate Select register.

**TABLE 16-19: FLOPPY DATA RATE SELECT SHADOW REGISTER**

HOST OFFSET	21h						8-bit	HOST SIZE	
POWER	VTR						n/a	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R	R	R	R	R	R	R	R	
BIT NAME	SRST	PD	Reserved	PRECOMP			DRS[1:0]		

## DRS

Data Rate Select 0 and Data Rate Select 1

## PRECOMP

PRECOMP 0, PRECOMP 1 and PRECOMP 2.

## PD

Power Down

## SRST

Soft Reset

### 16.3.19 UART 1 FIFO CONTROL SHADOW REGISTER

This register is a readable copy of the write-only UART 1 FIFO Control register.

**TABLE 16-20: UART 1 FIFO CONTROL SHADOW REGISTER**

HOST OFFSET	22h						8-bit	HOST SIZE	
POWER	VTR						n/a	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R	R	R	R	R	R	R	R	
BIT NAME	RTM	RTL	Reserved		DMS	XFR	RFR	FE	

## FE

FIFO Enable

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---

## Rfr

Receiver FIFO Reset.

## Xfr

Transmit FIFO Reset.

## DMS

DMA Mode Select

## RTL

Receiver Trigger (LSB)

## RTM

Receiver Trigger (MSB)

### 16.3.20 UART 2 FIFO CONTROL SHADOW REGISTER

This register is a readable copy of the write-only UART 2 FIFO Control register.

**TABLE 16-21: UART 2 FIFO CONTROL SHADOW REGISTER**

HOST OFFSET	23h					8-bit	HOST SIZE	
POWER	VTR					n/a	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
TYPE	R	R	R	R	R	R	R	R
BIT NAME	RTM	RTL	Reserved		DMS	XFR	RFR	FE

## FE

FIFO Enable

## Rfr

Receiver FIFO Reset.

## Xfr

Transmit FIFO Reset.

## DMS

DMA Mode Select

## RTL

Receiver Trigger (LSB)

## RTM

Receiver Trigger (MSB)

### 16.3.21 DEVICE DISABLE REGISTER

The enable bits in this register disable access to LPC logical devices by overriding the Valid bit in the Base Address Registers for each device.

**TABLE 16-22: DEVICE DISABLE REGISTER**

<b>HOST OFFSET</b>	24h			8-bit			<b>HOST SIZE</b>	
<b>POWER</b>	VTR			00h			<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>TYPE</b>	R/W	R/W	R/W	R	R/W	R	R	R/W
<b>BIT NAME</b>	PP_Disable	SP1_Disable	SP2_Disable	Reserved	Floppy_Disable	Reserved		FWP

## FWP

Floppy Write Protect

0=This bit has no effect: floppy write protection is controlled by the write protect pin or the forced write protect bit (bit 0 of register F1h in the Floppy Configuration space)

1= In this state, FWP overrides the write protect pin on the part and the forced write protect bit

WRTprt# (to the FDC Core) = (DS0# AND Force Write Protect) OR (DS1# AND Force Write Protect) OR WRTprt# (from the FDD Interface) OR Floppy Write Protect

## Floppy Disable

Floppy Disable

0=No effect: FDC access controlled by the Valid bit in the FDC BAR.

1= Floppy access disabled

## SP2\_Disable

Serial Port 2 Disable.

0=No effect: Serial Port 2 access controlled by the Valid bit in the Serial Port 2 BAR.

1= Serial Port 2 access disabled

## SP1\_Disable

Serial Port Disable

0=No effect: Serial Port 1 access controlled by the Valid bit in the Serial Port 1 BAR.

1= Serial Port 1 access disabled

## PP\_Disable

Parallel Port Disable

0=No effect: Parallel Port access controlled by the Valid bit in the Parallel Port BAR.

1= Parallel Port access disabled

## 16.3.22LED REGISTER

This register controls the operation of the YELLOW# and GREEN# pins This register is read-only unless the LED controlled by the YELLOW# and GREEN# pins is off or the system is in the S0 state with power on (SLP\_S3# and SLP\_S5# both de-asserted and PWRGD\_PS asserted).

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**TABLE 16-23: LED REGISTER**

<b>HOST OFFSET</b>	25h			8-bit			<b>HOST SIZE</b>	
<b>POWER</b>	VTR			00000000b			<b>nSYS_RST DEFAULT</b>	
				00000xxx b			<b>VCC RESET DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>TYPE</b>	R	R	R	R	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Reserved				Code_ Fetch	Color	Blink	

## Blink

Yellow/Green LED blink pattern

0=The LED is off

1= The LED blinks at a 1Hz rate with a 50% duty cycle (0.5 seconds on, 0.5 seconds off)

2=Reserved

3=The LED is on

This field is controlled by logic based on the SLP\_S3#, SLP\_S5# and PWRGD\_PS pins. See [Section 18.8, "LED Pins," on page 178](#).

## Color

Affects the color of the LED1 and LED2. The action is state dependent; see [Section 18.8, "LED Pins," on page 178](#).

## Code\_Fetch

This bit indicates BIOS progress.

0=BIOS has not reached code-fetch state

1= BIOS has reached code-fetch state

This bit is forced to 0 on VCC RESET.

**Note:** When [Code\\_Fetch](#) is set to '1b' by software, [Color](#) must be set to '1b' as well.

### 16.3.23 KEYBOARD SCAN REGISTER

**TABLE 16-24: KEYBOARD SCAN REGISTER**

<b>HOST OFFSET</b>	26h			8-bit			<b>HOST SIZE</b>	
<b>POWER</b>	VTR			00h			<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
<b>BIT NAME</b>	Scan_Code							

## Scan\_Code

Keyboard scan code, used in the Wake on Specific Key logic. See [Section 8.6, "Wake on Specific Key' Option,"](#) on [page 60](#).

### 16.3.24 POWER GOOD REGISTER

**TABLE 16-25: POWER GOOD REGISTER**

HOST OFFSET	27h			8-bit			HOST SIZE	
POWER	VTR			F1h			nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
TYPE	R/W	R/W	R/W	R/W	R	R	R/W	R/W
BIT NAME	PCIRST_OUT2_EN	PCIRST_OUT1_EN	PCIRST_OUT3_EN	PCIRST_OUT4_EN	Reserved		PWRGD_Lock	PWRGD_Delay

### PWRGD\_Delay

Selects an optional delay for the PWR\_GOOD\_3V signal.

0=Select no delay for PWR\_GOOD\_3V

1= Select PWR\_GOOD\_3V delay (default)

### PWRGD\_Lock

0=No lock operation (default)

1= Bit[0] and bit[1] of this register become read-only. They remain read-only until a VTR POR

### PCIRST\_OUT4\_EN

0=Pin PCI\_RST\_OUT4# forced low

1= Pin PCI\_RST\_OUT4# is a buffered copy of LRESET# (default)

### PCIRST\_OUT3\_EN

0=Pin PCI\_RST\_OUT3# forced low

1= Pin PCI\_RST\_OUT3# is a buffered copy of LRESET# (default)

### PCIRST\_OUT1\_EN

0=Pin PCI\_RST\_OUT3# forced low

1= Pin PCI\_RST\_OUT3# is a buffered copy of LRESET# (default)

### PCIRST\_OUT2\_EN

0=Pin PCI\_RST\_OUT4# forced low

1= Pin PCI\_RST\_OUT4# is a buffered copy of LRESET# (default)

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## 16.3.25 GPIO SELECT REGISTER

TABLE 16-26: GPIO SELECT REGISTER

HOST OFFSET	28h						8-bit	HOST SIZE	
POWER	VTR						00h	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R	R	R/W	R/W	R/W	R/W	R/W	R/W	
BIT NAME	Reserved			GPIO_Select					

### GPIO\_Select

This field selects which GPIO is readable in the [GPIO Read Register](#). [Table 16-27, "Select to GPIO Mapping"](#) shows the mapping between the value in GPIO\_Select (in decimal) and the GPIO selected.

TABLE 16-27: SELECT TO GPIO MAPPING

Select	GPIO	Select	GPIO	Select	GPIO	Select	GPIO
0	GP000	16	GP020	32	GP040	48	GP060
1	GP001	17	GP021	33	GP041	49	GP061
2	GP002	18	GP022	34	GP042	50	GP062
3	GP003	19	GP023	35	GP043	51	GP063
4	GP004	20	GP024	36	GP044	52	GP064
5	GP005	21	GP025	37	GP045	53	GP065
6	GP006	22	GP026	38	GP046	54	GP066
7	GP007	23	GP027	39	GP047	55	GP067
8	GP010	24	GP030	40	GP050	56	GP070
9	GP011	25	GP031	41	GP051	57	GP071
10	GP012	26	GP032	42	GP052	58	N/A
11	GP013	27	GP033	43	GP053	59	N/A
12	GP014	28	GP034	44	GP054	60	N/A
13	GP015	29	GP035	45	GP055	61	N/A
14	GP016	30	GP036	46	GP056	62	N/A
15	GP017	31	N/A	47	GP057	63	N/A

## 16.3.26 GPIO READ REGISTER

TABLE 16-28: GPIO READ REGISTER

HOST OFFSET	29h						8-bit	HOST SIZE	
POWER	VTR						00h	nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0	
TYPE	R	R	R	R	R	R	R	R	
BIT NAME	Reserved							GPIO_In	

### GPIO\_In

This field returns the value of the GPIO pin selected by [GPIO\\_Select](#), if enabled.

## 16.3.27 FIRMWARE EVENT STATUS REGISTER

**TABLE 16-29: FIRMWARE EVENT STATUS REGISTER**

<b>HOST OFFSET</b>	30h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	R/WC	
<b>BIT NAME</b>	Firmware_Event								

### Firmware\_Event

If any of these bits is '1b' and the corresponding bit in the [Firmware Event Enable Register](#) is set to '1b', the Firmware Event bit (FWE) in the PME and SMI Status registers is set to 1.

Each bit in this field is cleared when written with a '1b'. The ability to clear the bit can be disabled by the EC.

The EC can generate an interrupt to the Host by setting any bit in this field to '1b'. The EC can set bits to '1b'.

## 16.3.28 FIRMWARE EVENT ENABLE REGISTER

**TABLE 16-30: FIRMWARE EVENT ENABLE REGISTER**

<b>HOST OFFSET</b>	31h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>nSYS_RST DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Firmware_Event_Enable								

### Firmware\_Event\_Enable

Each bit that is set to '1b' in this field enables the generation of an SMI or PME event by the corresponding bit in the [Firmware\\_Event](#) field in the [Firmware Event Status Register](#).

## 16.3.29 POWER RECOVERY MODES REGISTER

**TABLE 16-31: POWER RECOVERY MODES REGISTER**

<b>HOST OFFSET</b>	32h						8-bit	<b>HOST SIZE</b>	
<b>POWER</b>	VTR						00h	<b>VBAT POR DEFAULT</b>	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R	
<b>BIT NAME</b>	PWR_State	Reserved							

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## PWR\_State

This bit saves the last state of the SLP\_S3# input when the power supply goes off (that is, this bit is set to the state of SLP\_S3# on the falling edge of the PWRGD\_PS input). The bit is used to determine last state of the system prior to a power failure:

0: Power supply was off (SLP\_S3# was asserted) (VBAT POR default)

1: Power supply was on (SLP\_S3# was de-asserted)

### 16.3.30 INTRUDER REGISTER

See [Section 17.0, "Intruder Detection Support," on page 169](#) for details on Intrusion Detection.

**TABLE 16-32: INTRUDER REGISTER**

HOST OFFSET	34h			8-bit			HOST SIZE	
POWER	VTR			See <a href="#">Note 16-3</a>			nSYS_RST DEFAULT	
BYTE0 BIT	D7	D6	D5	D4	D3	D2	D1	D0
TYPE	R	R	R	R	R	R	R	R/WC
BIT NAME	Reserved						INTRD_ STS	INTRUSION

## INTRUSION

When the INTRUDER# input goes high-to-low or low-to-high, this bit will be set. This bit is also set on VBAT POR. Software must write a '1' to clear this bit. Writes of '0' to this bit are ignored.

## INTRD\_STS

This bit indicates the current state of the INTRUDER# pin.

0: INTRUDER# pin is 0

1: INTRUDER# pin is 1

**Note 16-3** The VTR POR default value of this register depends on the current value of INTRD\_STS, which is derived directly from the INTRUDER# pin, and the VBAT-backed INTRUSION state bit. Possible combinations are:

00: No intrusion event; INTRUDER# pin currently 0

01: An intrusion event occurred; INTRUDER# pin currently 0

10: No intrusion event; INTRUDER# pin currently 1

11: An intrusion event occurred; INTRUDER# pin currently 1



## 17.0 INTRUDER DETECTION SUPPORT

A switch connected to the chassis cover indicates if the cover is on or off. When the cover is removed, the INTRUDER# input will transition from high-to-low or low-to-high depending on the type of switch used (normally open or normally closed).

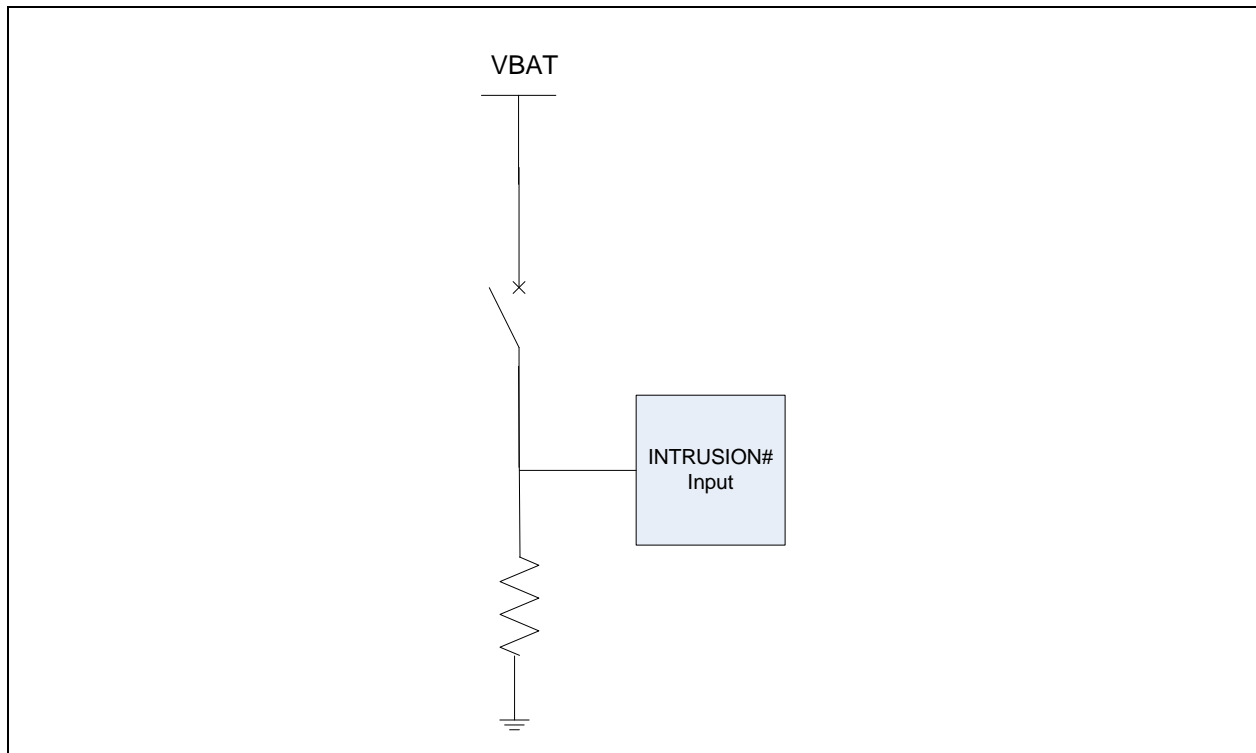
Whenever the INTRUDER# input goes high-to-low or low-to-high, the INTRUSION bit is set in the [Intruder Register](#) in the [Runtime Registers](#) LPC Logical Device (Logical Device Ah). The INTRUSION bit will remain set until cleared by software. This bit and input logic are powered by VBAT so that an intrusion condition is detected and stored even if VTR is removed. The INTRD\_STS bit indicates the current state of the INTRUDER# pin. This bit is in the [Intruder Register](#) in the [Runtime Registers](#) LPC Logical Device (Logical Device Ah).

### 17.1 Intrusion Bit

An intrusion event occurs when there is any transition of INTRUDER# (low-to-high or high-to-low). Any intrusion event will set the INTRUSION bit and also changes the PME and SMI status bits.

For minimal current drain on the battery, the recommended use of this pin is with a normally open switch as shown in Figure 17-1, "Recommended Intruder Pin Connection". When the cover is closed the input will be externally pulled down to ground. When the cover is opened this input will be pulled up to VBAT.

**FIGURE 17-1: RECOMMENDED INTRUDER PIN CONNECTION**



The INTRUSION bit will default to '1' on VBAT POR (battery removed and replaced or battery voltage below approximately 1.2V on VTR POR). The INTRUSION bit will therefore be set to '1' if an intrusion event occurs or if a VBAT POR occurs.

Writing '1' to the INTRUSION bit will clear it, regardless of the state of the INTRUDER# pin. Writing '0' to the INTRUSION bit has no effect.

## 17.2 PME and SMI Generation

The SMI and PME status bits for intrusion detection are set under VCC power, VTR power or on VTR POR, as they “shadow” the INTRUDER# bit. The SMI and PME status bits are cleared on a write of '1'. These bits cannot be cleared until the INTRUDER# pin goes low.

These bits function in one of three cases:

**Case 1.** An intrusion occurs under battery power only or a VBAT POR occurs. In this case, the event will be latched under battery power and the INTRUSION PME and SMI status bits will be set when VTR returns. Therefore, the PME and SMI status bits will have two possible default values on VTR POR, depending on whether or not the intrusion event occurred under battery power. When VTR returns, no enable bits are set, so there will be no PME or SMI generated. When VCC goes active, and the OS sets the enable bits, a PME and/or SMI will be generated. If the corresponding PME enable bit is set, a PME will be generated under VCC power. If the corresponding SMI enable bit is set, an SMI will be generated under VCC power. Therefore, in this case, setting the enable bit (low-to-high edge) will trigger the generation of the PME and SMI.

**Case 2.** An intrusion occurs under VTR power (VCC=0). In this case, the INTRUSION PME and SMI status bits will be set. If the corresponding PME enable bit is set, a PME will be generated under VTR power. If the corresponding SMI enable bit is set, an SMI will be generated under VTR power. In this case, setting the status bit (low-to-high edge) will trigger the generation of the PME and SMI.

**Case 3.** An intrusion occurs under VCC power. In this case, the INTRUSION PME and SMI status bits will be set. If the corresponding PME enable bit is set, a PME will be generated under VCC power. If the corresponding SMI enable bit is set, an SMI will be generated under VCC power. In this case, setting the status bit (low-to-high edge) will trigger the generation of the PME and SMI.

## 18.0 GLUE LOGIC HARDWARE

### 18.1 General Description

The Glue Logic Hardware provides several special purpose hardware blocks. These blocks include functions for:

- [LRESET# buffering](#)
- [Power Supply Turn On](#)
- [PWR\\_GOOD\\_3V Signal](#)
- [Resume Reset Signal Generation](#)
- [Backfeed Cut Functionality](#)
- [LED Pins](#)

### 18.2 Power, Clocks and Reset

#### 18.2.1 RESET

Glue logic is reset when nSYS\_RST is asserted.

#### 18.3 LRESET# buffering

The LRESET# input (Pin 16) can be used as an alternate function for a number of GPIO pins. When the LRESET# alternate function is selected, the GPIO pin follows the state of the LRESET# pin, and thus functions as a buffered copy of LRESET#.

The PCIRST\_OUT4#, PCIRST\_OUT3#, PCIRST\_OUT2# and PCIRST\_OUT1# functions are each associated with an enable bit in the [Power Good Register](#) located in Runtime Register offset 05h. The bits are VTR powered bit, and default to enabled ('1') on VTR POR. The bits operate as follows when the pins are configured for the LRESET# buffer function:

- When the associated enable bit is set to '1', the pins will operate as in [Table 18-1](#).
- When the associated enable bit is cleared to '0', the pins will be low ('0').

**TABLE 18-1: BUFFERED PCI RESET TRUTH TABLE**

Input	Enable	Output
PCI_RESET#	PCIRST_OUT1_EN, PCIRST_OUT2_EN, PCIRST_OUT3_EN, PCIRST_OUT4_EN	PCIRST_OUT1#, PCIRST_OUT2#, PCIRST_OUT3#, PCIRST_OUT4#
X	0	0
0	1	0
1	1	1

When VTR power is applied, and VCC RESET is asserted, the buffered LRESET# outputs are low.

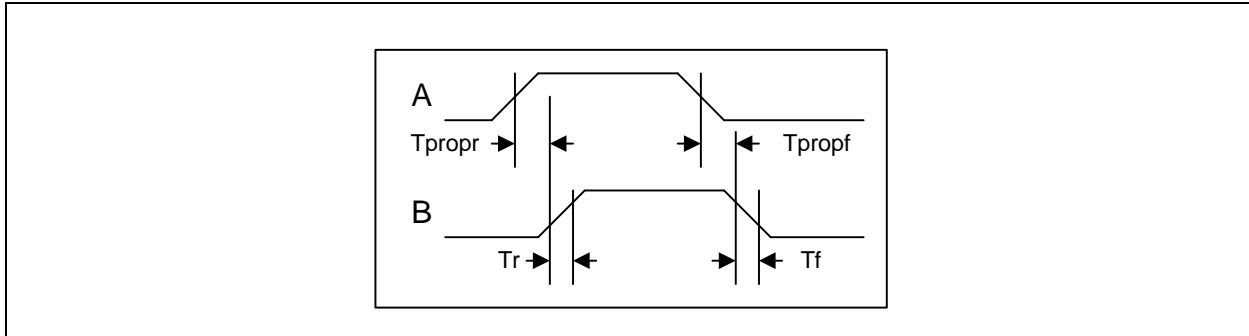
The timing values for the PCIRST\_OUT4#, PCIRST\_OUT3#, PCIRST\_OUT2# and PCIRST\_OUT1# signals are shown in [Table 18-2, "Buffered LRESET# Timing"](#). This values reference [Figure 18-1](#).

**TABLE 18-2: BUFFERED LRESET# TIMING**

Name	Description	MIN	TYP	MAX	Units
Tr	Buffered LRESET# signal low to high rise time. Measured from 90% to 10%			53	ns
Tpropf	Buffered LRESET# signal low to high propagation time. Measured from LRESET# to Buffered LRESET# signal.			30	ns
CO	Output Capacitance			25	pF
CL	Load Capacitance			40	pF

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**FIGURE 18-1: LRESET# RISE, FALL AND PROPAGATION TIMING**



## 18.4 Power Supply Turn On

The PS\_ON# signal is used to turn on the power supply. It is a function of SLP\_S3# according to the truth table below. The PS\_ON# is used as the power down signal for the power supply. Since PS\_ON# is an open drain output, it will need to be pulled up external to the chip if such a pull-up is not provided on the power supply. The power supply turn-on circuit behaves according to the table below.

**TABLE 18-3: PS\_ON# TRUTH TABLE**

Input	Output
SLP_S3#	PS_ON#
0	Hi-Z
1	0

## 18.5 PWR\_GOOD\_3V Signal

The PWR\_GOOD\_3V signal has a selectable delay to insert delay from ACPI power sequencing events to software runtime.

- **Negative edge (S0->S3/S5):** The 1-0 transition of SLP\_S3# input or the 1-0 transition (or 0 level) of PWRGD\_PS input would cause an immediate 1-0 transition (or 0 level) of PWR\_GOOD\_3V.
- **Positive edge (S3/S5->S0):** The 0-1 transition of PWRGD\_PS input would cause a 0-1 transition of PWR\_GOOD\_3V. The PWR\_GOOD\_3V transition is either immediate (no delay) or after a 100 ms (min) to 120 msec (max) delay from the 0-1 transition of PWRGD\_PS.
- The delay is optional and will be governed by a lockable select bit in the PWRGD DELAY register (Runtime Register at offset 51h). Default operation selects the delay. An internal delay indicator signal is used to indicate whether the 100-120 msec delay time has elapsed.
- All affected pins will retain the same electrical characteristics as they have now.
- PWR\_GOOD\_3V is forced to 0 and glitch-protected while VTR is rising.
- PWR\_GOOD\_3V is always 0 when the Resume Reset signal is asserted.

**TABLE 18-4: PWR\_GOOD\_3V OUTPUT**

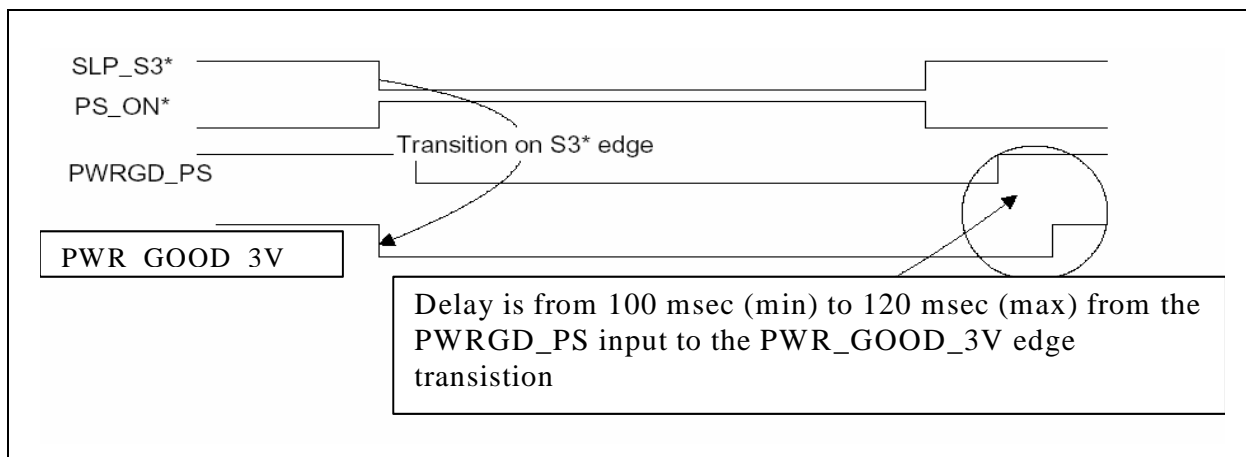
RSMRST#	SLP_S3#	PWRGD_PS	PWR_GOOD_3V Select Bit	Internal Delay Signal	PWR_GOOD_3V
0	X	X	X	X	0
1	1-0 transition or 0 level	X	X	X	0
1	X	1-0 transition or 0 level	X	X	0

**TABLE 18-4: PWR\_GOOD\_3V OUTPUT (CONTINUED)**

RSMRST#	SLP_S3#	PWRGD_PS	PWR_GOOD_3V Select Bit	Internal Delay Signal	PWR_GOOD_3V
1	1	0-1 transition	0	X	1 (no delay)
1	1	0-1 transition	1	0	0 (delay time not elapsed)
1	1	0-1 transition	1	1	1 (after 100-120 msec delay)

A timing diagram for this change is shown following:

**FIGURE 18-2: PWR\_GOOD\_3V GENERATION**



## 18.5.1 BITS FOR SELECTING AND LOCKING DELAY

Bits[1:0] in the [Power Good Register](#) at offset 27h of the Runtime Registers are used for selecting and locking the delay. The select bit (Bit[0]) selects the delay option as shown in [Table 18-4](#). The LOCK bit (Bit[1]) sets bits[1:0] to be Read Only. These bits remain RO until a VTR POR.

## 18.6 Resume Reset Signal Generation

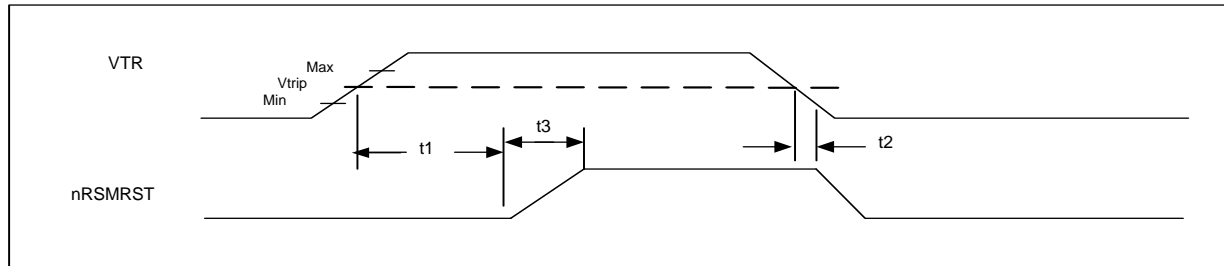
The RSMRST# signal is the reset output for the resume well power supply. This signal is used as a power on reset signal for the ICH.

RSMRST# is asserted by hardware and is also asserted and de-asserted by firmware. Hardware will not de-assert RSMRST#. EC Firmware controls the output level of RSMRST#. RSMRST# is forced to 0 and glitch-protected while VTR is rising.

The timing for the resume reset signal is given in [Figure 18-3](#) and [Table 18-5](#). The rising edge of RSMRST# is a delayed 3.3V buffered copy of VTR. This delay,  $t_{\text{RESET\_DELAY}}$ , starts when VTR hits the trip point,  $V_{\text{TRIP}}$  and is dependent on internal firmware. The delay is not programmable. Note the RSMRST# will be inactive high after the  $t_{\text{RESET\_DELAY}}$  only if VTR (3.3V) is present. Otherwise, RSMRST# will be active low beyond the  $t_{\text{RESET\_DELAY}}$  – until VTR (3.3V) goes active. On the falling edge there is minimal delay,  $t_{\text{RESET\_FALL}}$ . Note that  $V_{\text{TRIP}}$  shown in [Figure 18-3](#) has a  $V_{\text{TRIP\_MIN}}$  and a  $V_{\text{TRIP\_MAX}}$ .

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**FIGURE 18-3: RESUME RESET SEQUENCE**



**TABLE 18-5: RESUME REST TIMING**

Name	Description	MIN	TYP	MAX	Units	Notes
t1	Treset delay. VTR active to RSMRST# inactive	20	30	100	msec	
t2	Treset_fall. VTR below trip voltage to RSMRST# active (Glitch width allowance)			100	nsec	
t3	Treset_rise			100	nsec	
V <sub>TRIP</sub>	VTR low trip voltage	2.1	2.4	2.7	V	18-1

**Note 18-1** The trip point can vary between these limits on a per part basis, but on a given part it should remain relatively stable.

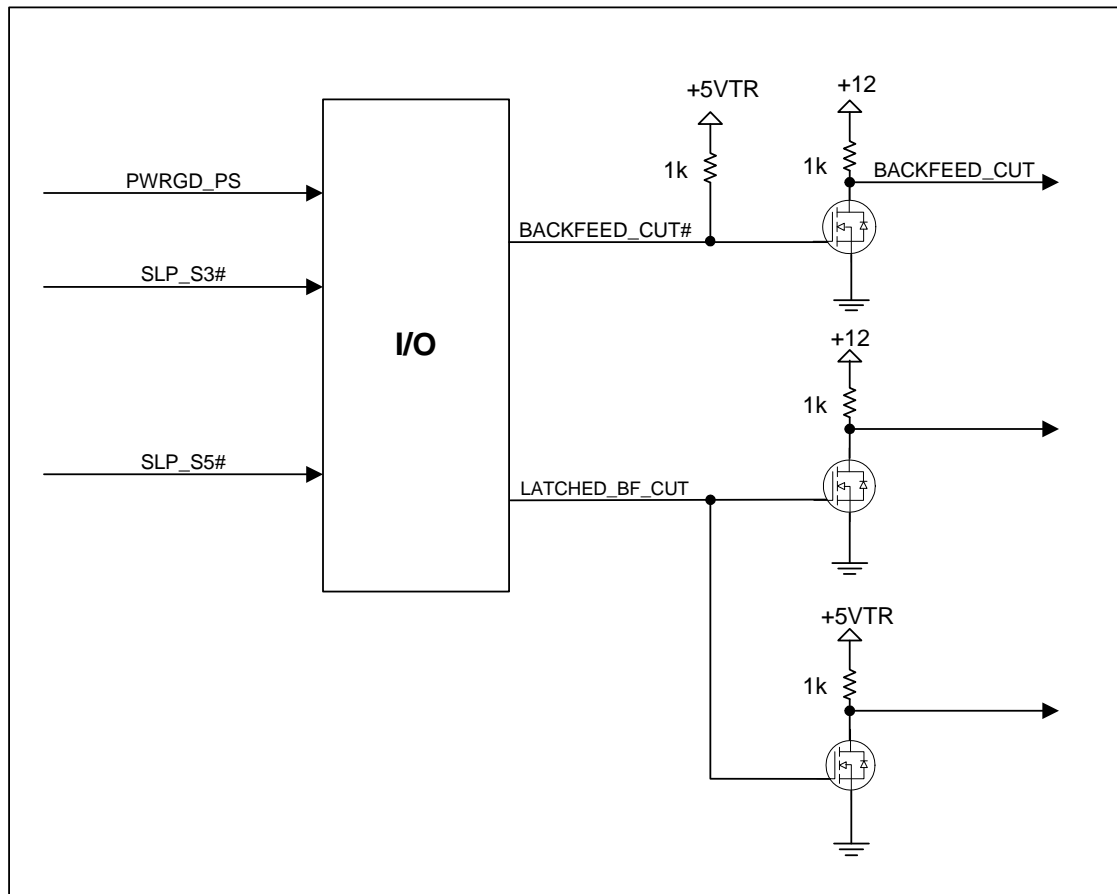
## 18.7 Backfeed Cut Functionality

BACKFEED\_CUT# is a signal required by the S3 power state circuitry and is powered by the VTR supply. It is a function of PWRGD\_PS and SLP\_S3# according to [Table 18-6, "BACKFEED\\_CUT# Truth Table"](#). BACKFEED\_CUT# is used to switch between the main voltage regulator and the suspend voltage regulator for various sub-systems when the system is transitioning into the S3 power state.

**TABLE 18-6: BACKFEED\_CUT# TRUTH TABLE**

Inputs		Output
PWRGD_PS	SLP_S3#	BACKFEED_CUT#
0	0	Hi-Z
0	1	Hi-Z
1	0	Hi-Z
1	1	0

**FIGURE 18-4: BACKFEED CUT AND LATCHED BACKFEED CUT CIRCUIT**



The LATCHED\_BF\_CUT is generated from BACKFEED\_CUT# and SLP\_S5#. It is powered by VTR. As shown in [Table 18-7, "LATCHED\\_BF\\_CUT Truth Table"](#), LATCHED\_BF\_CUT is unconditionally low if either SLP\_S5# or BACKFEED\_CUT# is low. LATCHED\_BF\_CUT will only go high on the rising edge of BACKFEED\_CUT# if SLP\_S5# is already high. Once high, LATCHED\_BF\_CUT goes low as soon as SLP\_S5# or BACKFEED\_CUT# goes low.

**TABLE 18-7: LATCHED\_BF\_CUT TRUTH TABLE**

Inputs		Output
BACKFEED_CUT# (Internal Signal)	SLP_S5#	LATCHED_BF_CUT
0	0	0
0	1	0
1	0	0
0 to 1 (rising edge)	1	1
'1' and no rising edge	1	No Change (18-2)

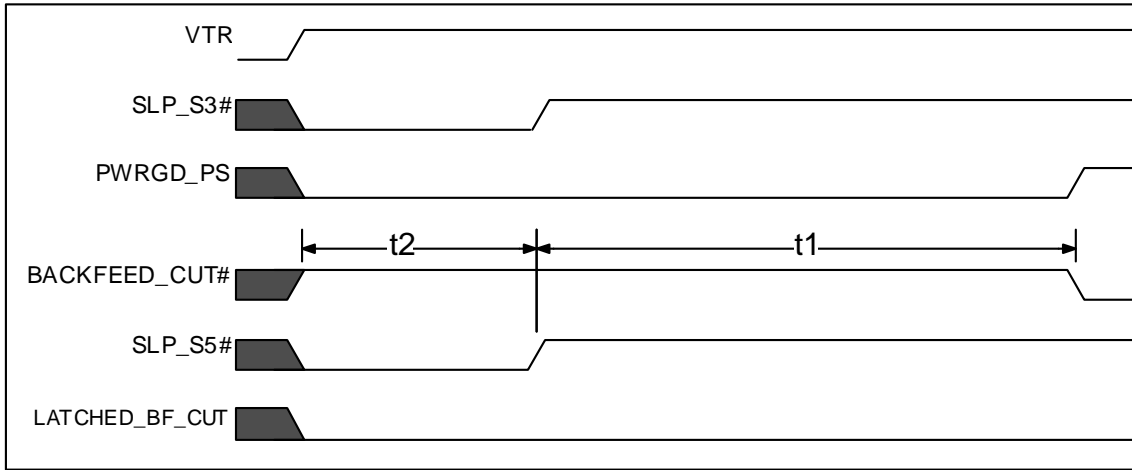
**Note 18-2** This is the condition when BACKFEED\_CUT# stays high and SLP\_S5# goes low and then high again (see [Figure 18-4](#)).

**APPLICATION NOTE:** The figure below shows the power up sequence. The BACKFEED\_CUT# signal follows the power rail up to its final value. The LATCHED\_BF\_CUT signal stays low and never turns on. The SLP\_S5# goes to its high value when the power rails have stabilized, approximately 25msec after power on. BACKFEED\_CUT# is pulled low a period t1 after SLP\_S5# goes high. The period t1 can be as short as 1msec. Typical measured values are approximately

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200msec. The t1 and t2 values are maintained by the inherent design of the system and are not controlled by the SCH5627P.

**FIGURE 18-5: LATCHED BACKFEED CUT POWER UP SEQUENCE**

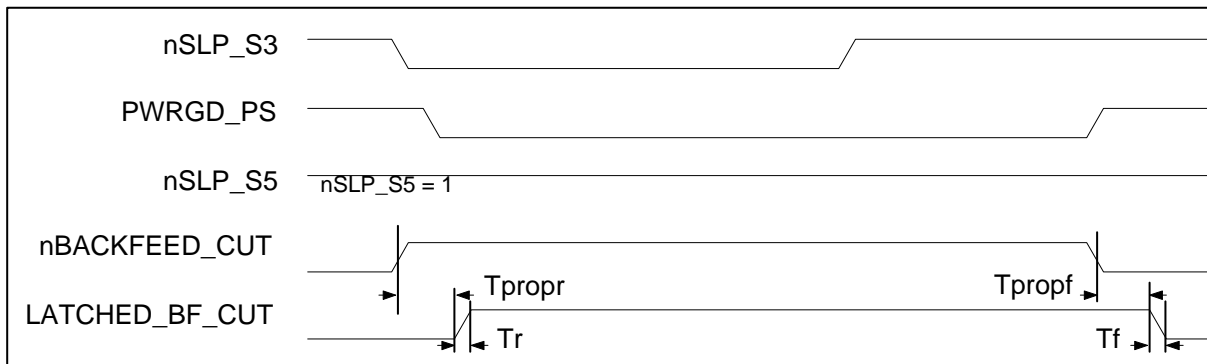


**TABLE 18-8: LATCHED BACKFEED CUT POWER UP SEQUENCE TIMING**

Name	Description	MIN	TYP	MAX	Units
t1	SLP_S5# inactive to BACKFEED_CUT# active	1	200		msec
t2	SLP_S5# inactive after power rails have stabilized		25		msec

**APPLICATION NOTE:** There are two possible timing sequences following the power up signal sequencing. The first possible sequence is with SLP\_S5# staying high and BACKFEED\_CUT# transitioning from low to high, remaining high for an undetermined period and then going back to low. At this point, the system returns to the end of the power-up sequence. During these BACKFEED\_CUT# transitions, the propagation delays, rise and fall times for LATCHED\_BF\_CUT are as described in the figure below. The first sequence can start at the end of the power-up sequence at any time.

**FIGURE 18-6: LATCHED BACKFEED CUT SEQUENCE 1**

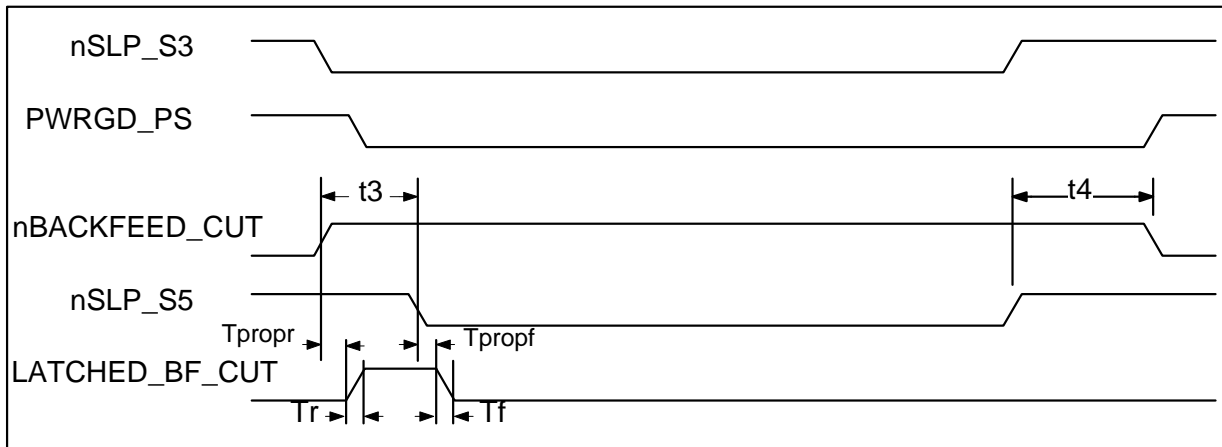


**APPLICATION NOTE:** The second possible sequence, shown in the figure below, is a normal powerdown sequence. The BACKFEED\_CUT# signal goes from low to high when SLP\_S3# goes low, and SLP\_S5# goes from high to low 30usec to 65usec (t3) later. The LATCHED\_BF\_CUT signal goes high when BACKFEED\_CUT# goes high and then LATCHED\_BF\_CUT returns



to low when SLP\_S5# goes low. The BACKFEED\_CUT# stays high and SLP\_S5# stays low for an indeterminate time and then SLP\_S5# will go high. A minimum of 1msec ( $t_4$ ) later, BACKFEED\_CUT# will go low and the system returns to the end of the power-up sequence when SLP\_S3# and PWRGD\_3V goes high. Typical measured values of  $t_4$  are approximately 250msec. During all transitions, the propagation delays, rise and fall times and power regulation times for LATCHED\_BF\_CUT are as described in Figure 18-7. The first sequence can start at the end of this power-up sequence at any time.

**FIGURE 18-7: LATCHED BACKFEED CUT SEQUENCE 2**

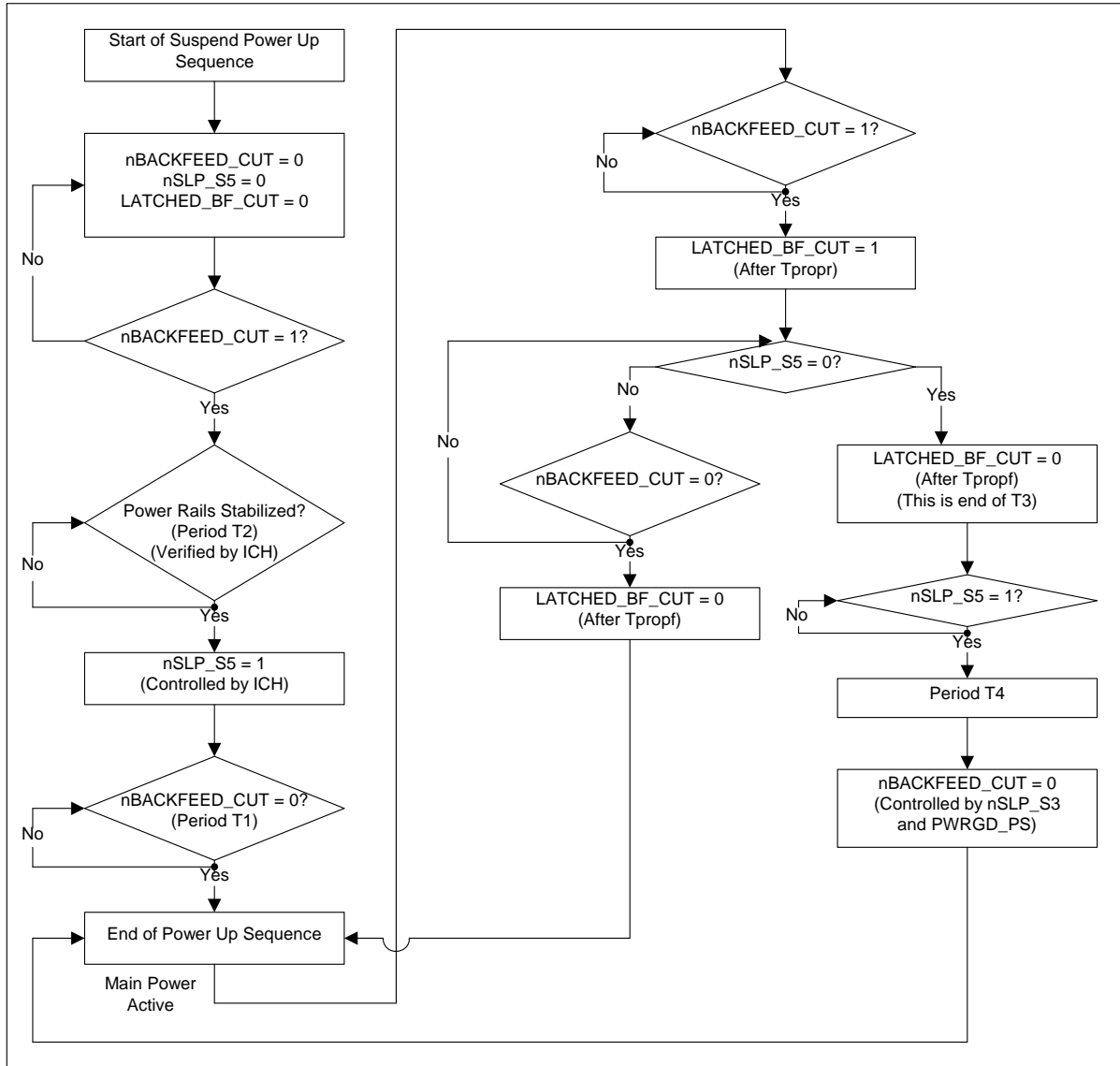


**TABLE 18-9: LATCHED BACKFEED CUT SEQUENCE 1 AND 2 TIMING**

Name	Description	MIN	TYP	MAX	Units
Tr	LATCHED_BF_CUT rise time. Measured from 10% to 90%.			1	us
Tf	LATCHED_BF_CUT fall time. Measured from 90% to 10%.			1	us
Tprop	LATCHED_BF_CUT high to low propagation delay. Measured from BACKFEED_CUT#/SLP_S5# threshold to 90% of LATCHED_BF_CUT			50	ns
Tprop	LATCHED_BF_CUT low to high propagation delay. Measured from BACKFEED_CUT#/SLP_S5# threshold to 10% of LATCHED_BF_CUT			50	ns
CO	Output Capacitance			25	pF
CL	Load Capacitance			50	pF
t3	BACKFEED_CUT# inactive to SLP_S5# active	30		60	us
t4	SLP_S5# inactive to BACKFEED_CUT# active	1	250		ms

**APPLICATION NOTE:** The following figure shows a flowchart of the logic.

FIGURE 18-8: LATCHED BACKFEED CUT FLOWCHART



## 18.8 LED Pins

The LED1#/GP006 and LED2#/GP007 functions on pin 25 and pin 26 can be used to control two LEDs or a Bi-Color LED. These pins default to LED functions with inverted, open-drain outputs (active low). The GPIO Configuration registers for GP006 and GP007 will have default values of inverted outputs on VTR POR. The LED pins can be configured to control a single bi-color LED or separate LEDs.

When connected to a Bi-Color LED, the two LED pins can configure the LED to be on or blinking in either of two colors. In this section, the colors will be called Color1 and Color2.

The LED pin functions control the LED as follows:

- The LED1# pin is low/blinking, the LED2# pin is high: LED is on/blinking, Color1.
- The LED2# pin is low/blinking, the LED1# pin is high: LED is on/blinking, Color2.
- Both the LED1# and LED2# pins are high: LED is off.

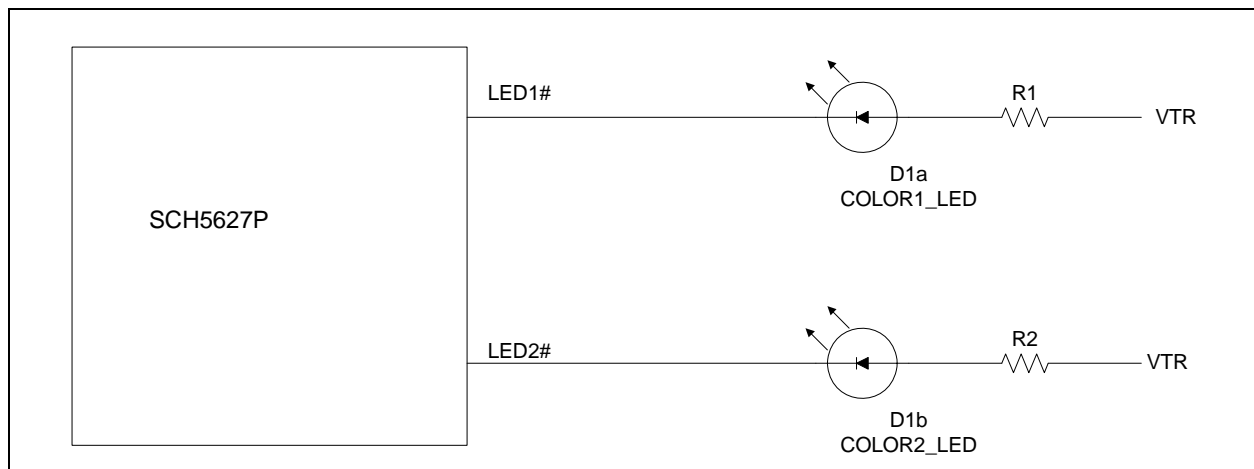
**TABLE 18-10: SUMMARY OF BEHAVIOR OF LED PINS**

State of LED1# Pin	State of LED2# Pin	State of LED
Low	High	On – Color1
Blinking	High	Blinking - Color1
High	Low	On – Color2
High	Blinking	Blinking – Color2
High	High	Off

Note that the polarity bit in the GP006 and GP007 Configuration registers affect the polarity of the LED1# and LED2# pin functions, respectively. The description below assumes inverted polarity (default).

The following figure shows the LED logic on the motherboard that will be used with the LED1# and LED2# pins. Note: This circuit is subject to change based on the polarity of the LED pins.

**FIGURE 18-9: LED1 AND LED2, MOTHERBOARD LOGIC ILLUSTRATION**



The SLP\_S5#, SLP\_S3#, PWRGD\_PS pins and the Code-Fetch Bit are inputs to the LED logic circuit. The conditions for different LED1# and LED2# state outputs are described below. Depending on the conditions below, the LED1# and LED2# pins will be either steady ON, OFF or will Blink at 1Hz with 50% duty cycle (500ms on, 500ms off). The LED logic circuit controls the state of the LEDs by controlling bits[3:0] in the [LED Register](#) in the Runtime Register Logical Device. In addition, under certain conditions software can write these bits to control the LEDs. The ON, OFF and Blink selection is done via Bits[1:0] in the [LED Register](#). The Color of the LEDs are programmable via Bits[3:2] of the [LED Register](#). See [Table 18-12 on page 180](#).

The [LED Register](#) is only writable when the system is the fully on state (the fully on state occurs in the S0 state with the PWRGD\_PS signal active high). Writing the [LED Register](#) in other states may result in indeterminate results. [Table 18-11](#) summarizes the Bi-Color LED functionality. Bits[2:0] of the LED register are controlled by the LED state machine when in the S3 state, in the S0 state when PWRGD\_PS is low, and on transitions of S5 and PWRGD\_PS. In other states, Bits[2:0] are set by software writing the LED register.

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**TABLE 18-11: LED STATES**

State	Inputs				LED Register Bits[2:0]		Outputs		
	SLP_ S5#	SLP_ S3#	PWRGD_ PS	LED Reg Bit[3] Code-fetch (18-4)	LED Reg Bit[2]	LED Reg Bit[1:0]	LED1# Pin	LED2# Pin	LED State
S5 (18-5)	0	X	X	X	0	00	1	1	LED1: Off LED2: Off
S3, no PWRGD_PS	1	0	0	X	1	01	1	1Hz, 50% duty cycle <sup>3</sup>	LED1: Off LED2: Blinking
S3, PWRGD_PS (18-3)	1	0	1	X	Prev	Prev	Prev	Prev	Previous State
S0, no PWRGD_PS	1	1	0	X	0	01	1Hz, 50% duty cycle <sup>3</sup>	1	LED1: Blinking LED2: Off
S0, PWRGD_PS, Code-Fetch = 0 (18-5)	1	1	1	0	0	11	0	1	LED1: Steady LED2: Off
S0, PWRGD_PS, Code Fetch = 1 (18-5)	1	1	1	1 (18-6)	1 (18-6)	11 (18-6)	1	0	LED1: Off LED2: Steady

**Note 18-3** This entry provides for the possibility of a delay from SLP\_S3# active to PWRGD\_PS inactive.

**Note 18-4** The Code-fetch bit is reset on VCC RESET.

**Note 18-5** LED Register writable in this state.

**Note 18-6** The COLOR bit (LED Reg Bit[2]), the Code Fetch bit (LED Reg Bit[3]) and the two Blink bits (LED Reg Bits[1:0]) must all be set to 1 in this state to change the LED to Color2. This is one of the states where the LED register bits is writable.

In the states wherein the LED register is writable, the LED pins are controlled by the LED register bits[3:0]. The Code Fetch bit (bit[3]) and the Color bit (bit[2]) must be set to the same value, either both 1 or both 0. The LED pins are controlled by bits [3:0] of the LED register as defined in Table 18-12.

**TABLE 18-12: LED STATES RESULTING FROM WRITING LED REGISTER**

LED Register Bits				LED State
Bit[3]	Bit[2]	Bit[1]	Bit[0]	
0	0	0	0	Color1: Off; Color2: Off
0	0	0	1	Color1: Blinking; Color2: Off
0	0	1	0	Color1: Off; Color2: Off
0	0	1	1	Color1: On; Color2: Off
0	1	0	0	Color1: Off; Color2: Off (18-7)
0	1	0	1	Color1: Off; Color2: Blinking (18-7)
0	1	1	0	Color1: Off; Color2: Off (18-7)
0	1	1	1	Color1: On; Color2: Off (18-7)
1	0	0	0	Color1: Off; Color2: Off (18-7)
1	0	0	1	Color1: Blinking; Color2: Off (18-7)
1	0	1	0	Color1: Off; Color2: Off (18-7)
1	0	1	1	Color1: Off; Color2: On (18-7)

**TABLE 18-12: LED STATES RESULTING FROM WRITING LED REGISTER (CONTINUED)**

LED Register Bits				LED State
1	1	0	0	Color1: Off; Color2: Off
1	1	0	1	Color1: Off; Color2: Blinking
1	1	1	0	Color1: Off; Color2: Off
1	1	1	1	Color1: Off; Color2: On

**Note 18-7** Bits[3:2] should be set to the same value. These LED states should never be entered due to these bit settings. They are included for completeness.

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## 19.0 GPIO INTERFACE

### 19.1 General Description

The SCH5627P [GPIO Interface](#) provides general purpose input monitoring and output control, as well as managing many aspects of pin functionality; including, multi-function [Pin Multiplexing Control](#), [Output Buffer Type](#) control, [PU/PD](#) resistors, asynchronous wakeup and synchronous [Interrupt Detection](#), [GPIO Direction](#), and [Polarity](#) control.

Features of the [GPIO Interface](#) include:

- Inputs:
  - Asynchronous rising and falling edge wakeup detection
  - Interrupt High or Low Level
- On Output:
  - Push Pull or Open Drain output
- Pull up or pull down resistor control
- Interrupt and wake capability available for all GPIOs
- 8 [Registers](#)
- Group- or individual control of GPIO data.
- Multiplexing of all multi-function pins are controlled by the GPIO interface

### 19.2 GPIO Indexing

Each GPIO signal function name consists of a 2-character prefix (“GP”) followed by a 3-digit octal-encoded index number. In the SCH5627P GPIO indexing is done sequentially starting from ‘GP000.’

### 19.3 Pin Multiplexing Control

Pin multiplexing depends upon the [Mux Control](#) bits in the [Pin Control Register](#). There is a [Pin Control Register](#) for each GPIO signal function.

[Table 19-1](#) shows all of the functions on each pin. Default function is assigned on nWDT\_RST., except for pins 120 and 121, as described by [Note 19-1](#). The default function is Function 0 unless otherwise noted.

**TABLE 19-1: COMPLETE LIST OF PIN FUNCTIONS**

Pin #	Pin Name (Default Function First)	Pin Functions			
		Function 0	Function 1	Function 2	Function 3
1	SER_IRQ	SER_IRQ	n/a	n/a	n/a
2	CAP1	CAP1	n/a	n/a	n/a
3	VSS	VSS	n/a	n/a	n/a
4	GP000 / PWM4	GP000	PWM4	n/a	n/a
5	GP001/ TACH4	GP001	TACH4	n/a	n/a
6	VCC	VCC	n/a	n/a	n/a
7	GP002 / PCIRST_OUT3#	GP002	PCIRST_OUT3#	n/a	n/a
8	GP003/ PCIRST_OUT4#	GP003	PCIRST_OUT4#	n/a	n/a
9	CLOCKI	CLOCKI	n/a	n/a	n/a
10	LAD0	LAD0	n/a	n/a	n/a
11	LAD1	LAD1	n/a	n/a	n/a
12	LAD2	LAD2	n/a	n/a	n/a
13	LAD3	LAD3	n/a	n/a	n/a
14	LFRAME#	LFRAME#	n/a	n/a	n/a

**TABLE 19-1: COMPLETE LIST OF PIN FUNCTIONS (CONTINUED)**

Pin #	Pin Name (Default Function First)	Pin Functions			
		Function 0	Function 1	Function 2	Function 3
15	LDRQ#	LDRQ#	n/a	n/a	n/a
16	LRESET# / GP074	GP074	LRESET# <b>Default</b>	n/a	n/a
17	GP004	GP004	n/a	n/a	n/a
18	PCICLK	PCICLK	n/a	n/a	n/a
19	VSS	VSS	n/a	n/a	n/a
20	AVSS	AVSS	n/a	n/a	n/a
21	CLK32	CLK32	n/a	n/a	n/a
22	GP005 / PECI_REQUEST#	GP005	PECI_ REQUEST#	n/a	n/a
23	VBAT	VBAT	n/a	n/a	n/a
24	VTR	VTR	n/a	n/a	n/a
25	LED1 / GP006	GP006	LED1 <b>Default</b>	n/a	n/a
26	LED2 / GP007	GP007	LED2 <b>Default</b>	n/a	n/a
27	SMBDAT2 / GP010	GP010	SMBDAT2 <b>Default</b>	n/a	n/a
28	SMBCLK2 / GP011	GP011	SMBCLK2 <b>Default</b>	n/a	n/a
29	(LAN_WAKE#) GP012	GP012	n/a	n/a	n/a
30	(VSB_CTRL) GP013	GP013	n/a	n/a	n/a
31	PECI VREF	PECI VREF	n/a	n/a	n/a
32	PECI / LVSMBCLK1 / GP072	GP072	PECI <b>Default</b>	LVSMBCLK1	n/a
33	PECI READY / LVSMBDAT1 / GP073	GP073	PECI READY <b>Default</b>	LVSMBDAT1	n/a
34	VTR	VTR	n/a	n/a	n/a
35	GP014/ INTRUSION# (see <a href="#">Note 19-2</a> )	GP014 / INTRUSION#	n/a	n/a	n/a
36	PWRBTN# / GP015 (see <a href="#">Note 19-2</a> )	PWRBTN# / GP015	n/a	n/a	n/a
37	VSS	VSS	n/a	n/a	n/a
38	PROCHOT_IN# / PROCHOT_OUT# / GP016	GP016	PROCHOT_IN# <b>Default</b>	PROCHOT_O UT#	n/a
39	TACH1 / GP017	GP017	TACH1 <b>Default</b>	n/a	n/a
40	TACH2 / GP020	GP020	TACH2 <b>Default</b>	n/a	n/a
41	TACH3 / GP021	GP021	TACH3 <b>Default</b>	n/a	n/a
42	HVSS	HVSS	n/a	n/a	n/a
43	Remote1+	Remote1+	n/a	n/a	n/a
44	Remote1-	Remote1-	n/a	n/a	n/a
45	Remote2+	Remote2+	n/a	n/a	n/a
46	Remote2-	Remote2-	n/a	n/a	n/a

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TABLE 19-1: COMPLETE LIST OF PIN FUNCTIONS (CONTINUED)

Pin #	Pin Name (Default Function First)	Pin Functions			
		Function 0	Function 1	Function 2	Function 3
47	HVTR	HVTR	n/a	n/a	n/a
48	V_IN	V_IN	n/a	n/a	n/a
49	GP022 / PWM1	GP022	PWM1	n/a	n/a
50	GP023 / PWM2	GP023	PWM2	n/a	n/a
51	GP024 / PWM3	GP024	PWM3	n/a	n/a
52	(PWRBTN_OUT#) GP025	GP025	n/a	n/a	n/a
53	PCIRST_OUT1 / GP026	GP026	PCIRST_OUT1 <b>Default</b>	n/a	n/a
54	PCIRST_OUT2 / GP027	GP027	PCIRST_OUT2 <b>Default</b>	n/a	n/a
55	PS_ON# / GP030	GP030	PS_ON# <b>Default</b>	n/a	n/a
56	GP031 / BACKFEED_CUT#	GPO31	n/a	BACKFEED_CUT# <b>Default</b>	n/a
57	VTR	VTR	n/a	n/a	n/a
58	GPO32	GP032	n/a	n/a	n/a
59	PWR_GOOD_3V / GP033	GP033	PWR_GOOD_3V <b>Default</b>	n/a	n/a
60	RSMRST# / GP034	GP034	RSMRST# <b>Default</b>	n/a	n/a
61	VSS	VSS	n/a	n/a	n/a
62	DSKCHG#	DSKCHG#	n/a	n/a	n/a
63	HDSEL#	HDSEL#	n/a	n/a	n/a
64	RDATA#	RDATA#	n/a	n/a	n/a
65	WRTPRT#	WRTPRT#	n/a	n/a	n/a
66	TRK0#	TRK0#	n/a	n/a	n/a
67	WGATE#	WGATE#	n/a	n/a	n/a
68	WDATA#	WDATA#	n/a	n/a	n/a
69	LATCHED_BF_CUT / GP035	GP035	n/a	LATCHED_BF_CUT <b>Default</b>	n/a
70	STEP#	STEP#	n/a	n/a	n/a
71	DIR#	DIR#	n/a	n/a	n/a
72	GP036 / SMBCLK1	GP036	SMBCLK1	n/a	n/a
73	DS0#	DS0#	n/a	n/a	n/a
74	GP040 / SMBDAT1	GP040	SMBDAT1	n/a	n/a
75	MTR0#	MTR0#	n/a	n/a	n/a
76	INDEX#	INDEX#	n/a	n/a	n/a
77	GP041 / IO_PME#	GP041	IO_PME#	n/a	n/a
78	GP042 / DRVDEN0	GP042	DRVDEN0	n/a	n/a
79	VTR	VTR	n/a	n/a	n/a
80	SLCT	SLCT	n/a	n/a	n/a
81	PE	PE	n/a	n/a	n/a
82	BUSY	BUSY	n/a	n/a	n/a



**TABLE 19-1: COMPLETE LIST OF PIN FUNCTIONS (CONTINUED)**

Pin #	Pin Name (Default Function First)	Pin Functions			
		Function 0	Function 1	Function 2	Function 3
83	ACK#	ACK#	n/a	n/a	n/a
84	PD7	PD7	n/a	n/a	n/a
85	PD6	PD6	n/a	n/a	n/a
86	PD5	PD5	n/a	n/a	n/a
87	PD4	PD4	n/a	n/a	n/a
88	PD3 / TMS	PD3	n/a	n/a	n/a
89	PD2 / TDO	PD2	n/a	n/a	n/a
90	PD1 / TDI	PD1	n/a	n/a	n/a
91	PD0 / TCK	PD0	n/a	n/a	n/a
92	VSS	VSS	n/a	n/a	n/a
93	SLCTIN#	SLCTIN#	n/a	n/a	n/a
94	INIT#	INIT#	n/a	n/a	n/a
95	ERROR#	ERROR#	n/a	n/a	n/a
96	ALF#	ALF#	n/a	n/a	n/a
97	STROBE#	STROBE#	n/a	n/a	n/a
98	DCD1# / GP043 / MCDAT	GP043	DCD1# <b>Default</b>	MCDAT	n/a
99	DSR1# / GP044 / MCCLK	GP044	DSR1# <b>Default</b>	MCCLK	n/a
100	RXD1 / GP045	GP045	RXD1 <b>Default</b>	n/a	n/a
101	RTS1# / GP046 [SYSOPT]	GP046	RTS1# <b>Default</b>	n/a	n/a
102	GP047 / TXD1	GP047	TXD1 <b>Default</b>	n/a	n/a
103	CTS1# / GP050	GP050	CTS1# <b>Default</b>	n/a	n/a
104	DTR1# [TEST_EN] / GP051	GP051	DTR1# <b>Default</b>	n/a	n/a
105	RI1# / GP052	GP052	RI1# <b>Default</b>	n/a	n/a
106	VTR	VTR	n/a	n/a	n/a
107	GP053 / DCD2#	GP053	DCD2#	n/a	n/a
108	GP054 / DSR2#	GP054	DSR2#	n/a	n/a
109	GP055 / RXD2	GP055	RXD2	n/a	n/a
110	GP056 / RTS2#	GP056	RTS2#	n/a	n/a
111	GP057 / TXD2	GP057	TXD2	n/a	n/a
112	GP060 / CTS2#	GP 060	CTS2#	n/a	n/a
113	GP 061 / DTR2#	GP061	DTR2#	n/a	n/a
114	GP062 / RI2#	GP062	RI2#	n/a	n/a
115	KCLK	KCLK	n/a	n/a	n/a
116	KDAT	KDAT	n/a	n/a	n/a
117	MCLK	MCLK	n/a	n/a	n/a
118	MDAT	MDAT	n/a	n/a	n/a
119	VSS	VSS	n/a	n/a	n/a

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**TABLE 19-1: COMPLETE LIST OF PIN FUNCTIONS (CONTINUED)**

Pin #	Pin Name (Default Function First)	Pin Functions			
		Function 0	Function 1	Function 2	Function 3
120	GP063 / KBDRST# (Note 19-1)	GP063	KBDRST#	n/a	n/a
121	GP064 / A20M (Note 19-1)	GP064	A20M	n/a	n/a
122	VTR	VTR	n/a	n/a	n/a
123	SLP_S3# / GP065	GP065	SLP_S3# Default	n/a	n/a
124	SLP_S4_S5# / GP066	GP066	SLP_S4_S5# Default	n/a	n/a
125	PWRGD_PS / GP067	GP067	PWRGD_PS Default	n/a	n/a
126	TRST#	TRST#	n/a	n/a	n/a
127	GP070 / SPEAKER	GP070	SPEAKER	n/a	n/a
128	GP071 / IO_SMI#	GP071	IO_SMI#	n/a	n/a

**Note 19-1** The pin mux function for this pin is only reset on nSYS\_RST. The nWDT\_RST signal does not change the current pin configuration.

**Note 19-2** The PWRBTN# and INTRUSION# functions are always enabled, in parallel with the GPIO function. The pin function multiplex control is not used.

## 19.4 Power, Clocks and Reset

### 19.4.1 RESET

This block is reset on a nSYS\_RST. On reset, all Registers are reset to their default values.

## 19.5 Registers

**TABLE 19-2: GPIO INTERFACE REGISTER SUMMARY**

Register Name	Host I/O Offset	SPB Offset	Size	Type	Notes
<a href="#">Pin Control Register</a>	-	000h - 200h	32	R/W	

## 19.6 Pin Control Register Table

Default values for the Pin Control registers are shown in [Table 19-2, "GPIO Interface Register Summary"](#):

**TABLE 19-3: GPIO PIN CONTROL REGISTER DEFAULT TABLE**

GPIO	DFLT	GPIO	DFLT	GPIO	DFLT
GP000	0000_0000h	GP025	0000_0000h	GP052	0000_1000h
GP001	0000_0000h	GP026	0000_1200h	GP053	0000_0000h
GP002	0000_0000h	GP027	0000_1200h	GP054	0000_0000h
GP003	0000_0000h	GP030	0000_1300h	GP055	0000_0000h
GP004	0000_1200h	GP031	0000_0000h	GP056	0000_0000h
GP005	0000_0000h	GP032	0000_1200h	GP057	0000_0000h
GP006	0000_1B00h	GP033	0000_1200h	GP060	0000_0000h
GP007	0000_1B00h	GP034	0000_1200h	GP061	0000_0000h
GP010	0000_1300h	GP035	0000_2200h	GP062	0000_0000h
GP011	0000_1300h	GP036	0000_0000h	GP063	0000_0000h
GP012	0000_1000h	RES	0000_0000h	GP064	0000_0000h
GP013	0000_1200h	GP040	0000_0000h	GP065	0000_1000h
GP014	0000_0000h	GP041	0000_0000h	GP066	0000_1000h
GP015	0000_0000h	GP042	0000_0000h	GP067	0000_1000h
GP016	0000_1000h	GP043	0000_1000h	GP070	0000_0000h
GP017	0000_1000h	GP044	0000_1000h	GP071	0000_0000h
GP020	0000_1000h	GP045	0000_1000h	GP072	0000_1000h
GP021	0000_1000h	GP046	0000_1200h	GP073	0000_1000h
GP022	0000_0000h	GP047	0000_0000h	GP074	0000_1000h
GP023	0000_0000h	GP050	0000_1000h	RES	0000_0000h
GP024	0000_0000h	GP051	0000_1200h	RES	0000_0000h

**Note 19-3** The only field that can be modified in the pin control register for GP067, the register located at offset 0DCh, is the Interrupt Detection field. Other fields, such as the [Mux Control](#) and [GPIO Direction](#), are fixed at their default values.

**Note 19-4** The Pin Control registers for GP063 and GP064 are only reset on nSYS\_RST. All other GPIO Pin Control registers are reset on nWDT\_RST.

The [Pin Control Register](#) format is illustrated in [Table 19-4](#) below and described in the subsections that follow. [Pin Control Register](#) address offsets and defaults are defined in [Section 19.2, "GPIO Indexing," on page 182](#).

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## 19.6.1 PIN CONTROL REGISTER

**TABLE 19-4: PIN CONTROL REGISTER**

<b>HOST ADDRESS</b>	N/A			N/A			<b>HOST SIZE</b>		
				32-bit			<b>EC SIZE</b>		
<b>POWER</b>	VTR			See Table 19-2 on page 186			<b>nWDT_RST DEFAULT</b>		
<b>BYTE3 BIT</b>	<b>D31</b>	<b>D30</b>	<b>D29</b>	<b>D28</b>	<b>D27</b>	<b>D26</b>	<b>D25</b>	<b>D24</b>	
<b>TYPE</b>	R	R	R	R	R	R	R	R	
<b>BIT NAME</b>	Reserved							GPIO input from pad	
<b>BYTE2 BIT</b>	<b>D23</b>	<b>D22</b>	<b>D21</b>	<b>D20</b>	<b>D19</b>	<b>D18</b>	<b>D17</b>	<b>D16</b>	
<b>TYPE</b>	R	R	R	R	R	R	R/W	R/W	
<b>BIT NAME</b>	Reserved						Alternative GPIO Write Enable		
<b>BYTE1 BIT</b>	<b>D15</b>	<b>D14</b>	<b>D13</b>	<b>D12</b>	<b>D11</b>	<b>D10</b>	<b>D9</b>	<b>D8</b>	
<b>TYPE</b>	R	R	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Reserved		Mux Control		Polarity	Reserved	GPIO Direction	Output Buffer Type	
<b>BYTE0 BIT</b>	<b>D7</b>	<b>D6</b>	<b>D5</b>	<b>D4</b>	<b>D3</b>	<b>D2</b>	<b>D1</b>	<b>D0</b>	
<b>TYPE</b>	R/W	R/W	R/W	R/W	R	R	R/W		
<b>BIT NAME</b>	Edge Enable		Interrupt Detection		Reserved		PU/PD		

### PU/PD

**TABLE 19-5: PU/PD BITS DEFINITION**

Bit 1	Bit 0	Selected Function
0	0	None
0	1	Pull Up Enabled
1	0	Pull Down Enabled
1	1	None

### Interrupt Detection

**TABLE 19-6: INTERRUPT DETECTION BITS DEFINITION**

D6	D5	D4	Selected Function
0	0	0	
0	0	1	
0	1	0	Reserved
0	1	1	Reserved
1	0	0	Reserved
1	0	1	Rising Edge Triggered

**TABLE 19-6: INTERRUPT DETECTION BITS DEFINITION (CONTINUED)**

D6	D5	D4	Selected Function
1	1	0	Falling Edge Triggered
1	1	1	Either edge triggered

**Note 19-5** Only edge triggered interrupts can wake up the main ring oscillator. The GPIO must be configured for edge-triggered interrupts ([Interrupt Detection](#) set to 101b - 111b), edge-triggered interrupts must be enabled ([Edge Enable](#) set to 1b) and the GPIO interrupt must be enabled in the interrupt aggregator in order to wake up the ring when the ring is shut down.

## Edge Enable

When this bit is '1', the GPIO has edge detection enabled. When this bit is '0', edge detection is disabled.

When this bit is '0', the ring oscillator wakeup function is disabled. In order to put the pin in its lowest power state, the Edge Enable bit should be set to '0', and the [Interrupt Detection](#) field set to one of the edge triggered values (101b - 111b). This combination ensures that no interrupt will be generated and that no wakeup function will be enabled.

**TABLE 19-7: EDGE ENABLE BIT DEFINITION**

D7	Description
0	Edge detection disabled
1	Edge detection enabled

## OUTPUT BUFFER TYPE

**TABLE 19-8: OUTPUT BUFFER TYPE BIT DEFINITION**

D8	Selected Function
0	Push-Pull
1	Open Drain

**Note 19-6** Unless explicitly stated otherwise, pins with (I/O/OD) or (O/OD) in their buffer type column in the tables in [Section TABLE 3-1: "Signal Descriptions," on page 11](#) are compliant with the following Programmable OD/PP Multiplexing Design Rule: Each compliant pin has a programmable open drain/push-pull buffer controlled by the [Output Buffer Type](#) bit in the associated [Pin Control Register](#). The state of this bit controls the mode of the interface buffer for all selected functions, including the GPIO function.

## GPIO Direction

The [GPIO Direction](#) bit controls the buffer direction only when the [Mux Control](#) field is '00' selecting the pin signal function to be GPIO. When the [Mux Control](#) field is greater than '00' (i.e., a non-GPIO signal function is selected) the [GPIO Direction](#) bit has no affect and the selected signal function logic directly controls the pin direction.

**TABLE 19-9: GPIO DIRECTION BIT DEFINITION**

D9	Selected Function
0	Input
1	Output

## Polarity

When the [Polarity](#) bit is set to '1' and the [Mux Control](#) bits are greater than '00,' the selected signal function outputs are inverted and [Interrupt Detection](#) sense defined in [Table 19-6, "Interrupt Detection Bits Definition"](#) is inverted. When the [Mux Control](#) field selects the GPIO signal function (Mux = '00'), the [Polarity](#) bit does not effect the output. Regardless of the state of the [Mux Control](#) field and the [Polarity](#) bit, the state of the pin is always reported without inversion in the GPIO input register.

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**TABLE 19-10: POLARITY BIT DEFINITION**

D11	Description
0	Non-inverted
1	Inverted

## Mux Control

**TABLE 19-11: MUX CONTROL BIT DEFINITION**

D13	D12	Description
0	0	GPIO Function Selected
0	1	Signal Function 1 Selected
1	0	Signal Function 2 Selected
1	1	Signal Function 3 Selected

The [Mux Control](#) field determines the active signal function for a pin as defined in [Table 19-11](#).

## 20.0 JTAG AND XNOR

### 20.1 General Description

This sections describes functions for debug and test. The SCH5627P includes a JTAG port for testing and debugging. The [XNOR Chain](#) for board test is also included in this section.

### 20.2 JTAG Port Signal Interface Description

The signal pins are defined in [Table 3-1, "Signal Descriptions," on page 11](#).

The TCK input is the clock that drives the JTAG interface. It is asynchronous to other clocks on-chip.

The TMS input is sampled on each rising edge of JTAG\_CLK, and governs the transitions among the 16 states of the state machine (TAP) that controls the transfer of data.

The TDI input is the serial data input, shifted in during the Shift-IR and Shift-DR states of the TAP. It is sampled on rising edges of JTAG\_CLK.

The TDO output is the serial data output. It is presented on falling edges of JTAG\_CLK, 1/2 clock before each input shift, to provide setup and hold time to the next JTAG controller in the chain. The final TDO output pin, after all on-chip chaining is held in high-impedance mode (floating) except when valid data is being presented. The enabled/disabled state of the pin is also changed on falling edges of JTAG\_CLK.

The TRST# input is provides the [Async JTAG RESET](#). Note that the reset state of the JTAG port is only local to the JTAG port: its effect is to keep the JTAG port in an idle state and to disengage it from the rest of the system, so that it does not affect other on-chip logic in this state.

### 20.3 Power, Clocks and Reset

See [Section 22.14, "JTAG Interface Timing," on page 225](#) power on sequence and reset timing.

#### 20.3.1 POWER DOMAINS

The JTAG block is powered by VTR.

#### 20.3.2 CLOCKS

The JTAG port runs internally from the externally-provided JTAG\_CLK clock pulses only. There is no requirement for JTAG\_CLK to be constantly running.

#### 20.3.3 RESET

The ARC JTAG block has two resets: [Async JTAG RESET](#) by its TRST# input and [Sync JTAG RESET](#) by JTAG protocol.

##### 20.3.3.1 Async JTAG RESET

The TRST# pin provides the [Async JTAG RESET](#) to the JTAG Registers. The TRST# pin has an active low, asynchronous assertion and a synchronous de-assertion. The JTAG Registers will be reset asynchronously (and immediately) upon the active low TRST# assertion. Once the TRST# pin has been de-asserted, a delay of three JTAG\_CLK's is required in order to access the JTAG Registers. The JTAG Registers will remain in reset until the three clocks complete the synchronous TRST# pin de-assertion. See [Section 22.14, "JTAG Interface Timing," on page 225](#).

**APPLICATION NOTE:** After asserting and de-asserted the TRST# pin, a [Sync JTAG RESET](#) can be applied before starting to access the JTAG Registers (to meet the TRST# synchronous de-assertion requirement).

JTAG registers, in particular the [JTAG Test Mode Data Registers](#), are set to their initial values by the assertion of the TRST# pin, not the VTR Power On Reset. TRST# must be held low while the SCH5627P is powering up so the registers can be set to their proper default values. If TRST# is high during power up, the [JTAG Test Mode Data Registers](#) may be set to unpredictable values, which may trigger unwanted test modes.

Care should be taken during VTR power up to insure that TRST# is asserted for a longer time than the VTR rise time due to capacitive loading.

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## 20.3.3.2 Sync JTAG RESET

It can also be reset synchronously by a JTAG\_CLK / TMS sequence, in accordance with the JTAG standard. A series of 5 successive JTAG\_CLK rising edges, with TMS held high throughout, will accomplish this from any state.

The ARC JTAG port, upon entering its Reset state, will be prepared to accept an Instruction or Data transfer. It will also be disengaged from external circuitry, allowing it to operate normally.

The initial contents of the Instruction Register are the IDCODE command (Ch). If a Data transfer is performed first after Reset, without an preceding Instruction transfer, then the IDCODE value will be loaded into its 32-bit shift register and presented serially, after which will appear the bits shifted in from TDI.

The initial contents of the Data registers are as listed in [Table 20-1, "JTAG Instruction Register Encodings," on page 196.](#)

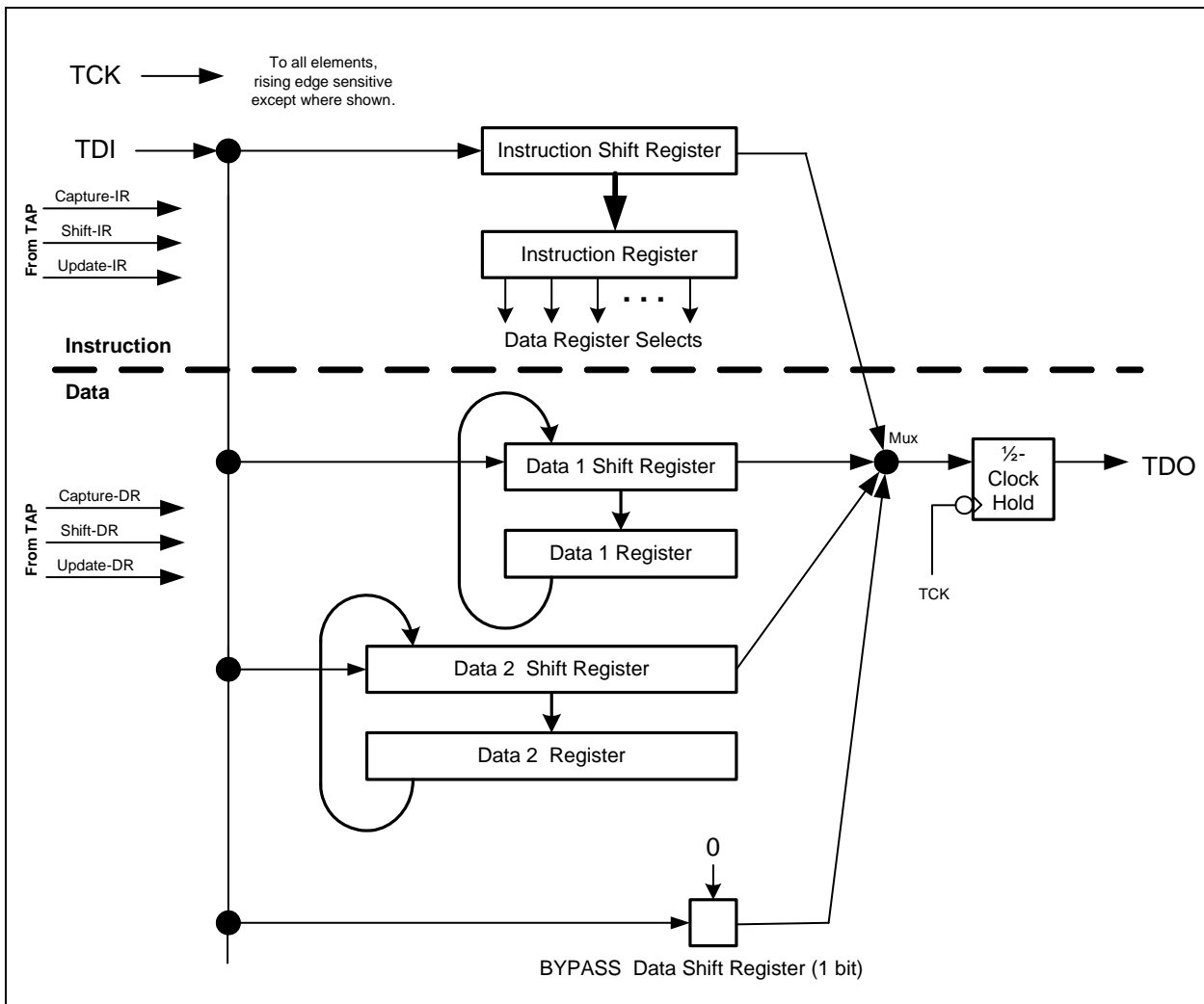
## 20.4 JTAG Background

The following is a simplified description, intended to provide background for the ARC JTAG port. For full details, see the JTAG specification (IEEE Standards 1149.1 and 1149.1b).

### 20.4.1 INTERNAL STRUCTURE

A JTAG port operates by transferring information serially into and out of an Instruction register and one or more Data registers. These registers are connected in parallel with each other, and can be of arbitrary length. See [Figure 20-1.](#)

**FIGURE 20-1: STRUCTURE OF A JTAG PORT (SIMPLIFIED)**





The protocol for shifting information makes a distinction between an Instruction transfer (to/from a single Instruction register) and a Data transfer (to/from one of several Data registers). The Instruction register is handled separately because it selects which specific Data register is accessed by subsequent Data transfers.

In daisy-chained JTAG controllers, the Instruction registers form one chain, and the currently-selected set of Data registers in each JTAG controller combine to form a second chain. To shorten the Data chain when not all JTAG controllers are of interest, a mandatory one-bit Data register called BYPASS is provided. There is no bypassing for the Instruction chain, so its full length must be shifted as each new instruction is transferred anywhere. Selecting the BYPASS Data register is the equivalent of a No-Operation instruction for a JTAG controller, and this instruction is always defined as a '1' in all Instruction register bits.

Each entity called a "Register" actually consists of two parts: the Register itself, and an associated Shift Register which connects to TDI and TDO. The Register may load from, and/or source information in parallel to, the Shift Register. These two parts are the same length, meaning that (for example) a 5-bit Register will be associated with a 5-bit Shift Register.

The Instruction register and the Data registers respond to decoded state signals from the TAP Controller sub-block (Section 20.4.2), which represent sub-steps of a transfer. The sub-steps they perform are **Capture**, which loads the shift register in parallel, **Shift**, which shifts information in from TDI and out on TDO, and **Update**, which writes information from the Shift Register in parallel. The **Capture-IR**, **Shift-IR** and **Update-IR** controls affect only the Instruction register. The **Capture-DR**, **Shift-DR** and **Update-DR** controls affect only the Data register that is currently selected by the contents of the Instruction register.

## 20.4.2 TAP CONTROLLER AND PROTOCOL

The JTAG protocol is driven by the level of the TMS (Test Mode Select) input pin at each rising edge of the JTAG\_CLK clock. This is the responsibility of the TAP Controller section of the JTAG controller, which performs state transitions as illustrated in the state diagram in Figure 20-2. States whose names end with "IR" affect the Instruction register (the right-most column of states in Figure 20-2), and those ending with "DR" affect a Data register (the middle column in Figure 20-2). Note that the TMS signal goes in parallel to all JTAG ports in a chain, so they are always in the same protocol state. The sequence of accessing any register is as follows:

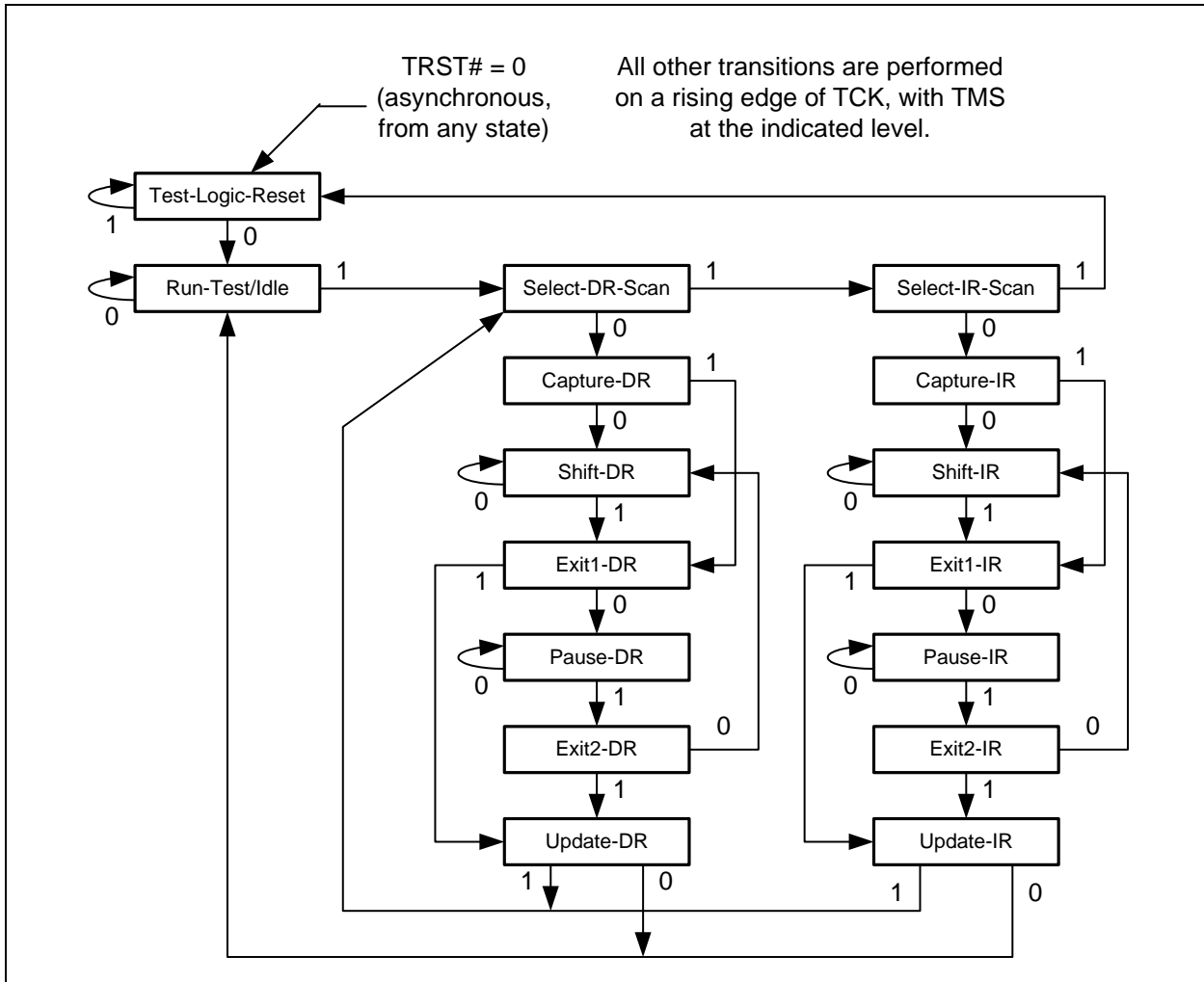
- Capture (IR or DR), which loads a shift register from its source in preparation for shifting it out. In the case of the Instruction register, this is a fixed value, and not the previous contents of the Instruction register. In the case of the BYPASS Data register, this is a fixed '0' value. The Capture state is transitory, being present for only one JTAG\_CLK cycle, once per transfer.
- Shift (IR or DR), which shifts the Captured information in the Shift Register out on the TDO pin while also shifting information in from the TDI pin. The registers (by convention) shift from left to right, so the least-significant bit of a value is transferred first. This state may be held arbitrarily (holding TMS=0) to shift as many bits as desired.
- Update (IR or DR), which loads a Register from its Shift Register after the shifting has completed. The Update state is transitory, being present for only one JTAG\_CLK cycle, once per transfer.

There is also a Pause state (IR or DR) which may be used to exit and re-enter the Shift state without terminating the transfer in progress. This state may be held (TMS=0) in order to delay for any desired number of JTAG\_CLK cycles.

Outside of Instruction or Data transfers, there are two states which may be entered and held. These are shown in the leftmost column in Figure 20-2.

- The Test-Logic-Reset state holds the JTAG logic in its reset state. This re-initializes the registers that are internal to the JTAG logic. This state is entered asynchronously by assertion of TRST# low, and it can be seen in Figure 20-2 that, from any other state, this state will be entered by 5 successive JTAG\_CLK cycles with TMS held to '1'.
- Run-Test/Idle holds JTAG logic idle, but not reset, between transfers.

**FIGURE 20-2: TAP CONTROLLER STATE DIAGRAM**



### 20.4.3 INTERFACE TIMING EXAMPLE

Figure 20-3 illustrates the timing relationship between data shifting and the TAP Controller’s Shift states, using a 1-bit Data register as an example. (This is in fact the exact situation when the BYPASS Data register is selected: refer to FIGURE 20-1: on page 192.)

The TAP Controller changes states on each rising edge of JTAG\_CLK, traversing the state table in Figure 20-2 as directed by the TMS input signal from the external interface.

Previous to the waveform in Figure 20-3, the TAP Controller has already passed through a Capture-DR state, so the 1-bit Shift Register has been pre-loaded with a “Capture Value”, either from its associated parallel Register or from another source. (For the BYPASS register, this would be a fixed ‘0’.)

At the first rising edge of JTAG\_CLK in Figure 20-3, the Shift-DR state is being entered. As yet, no valid data needs to be present on TDI or TDO.

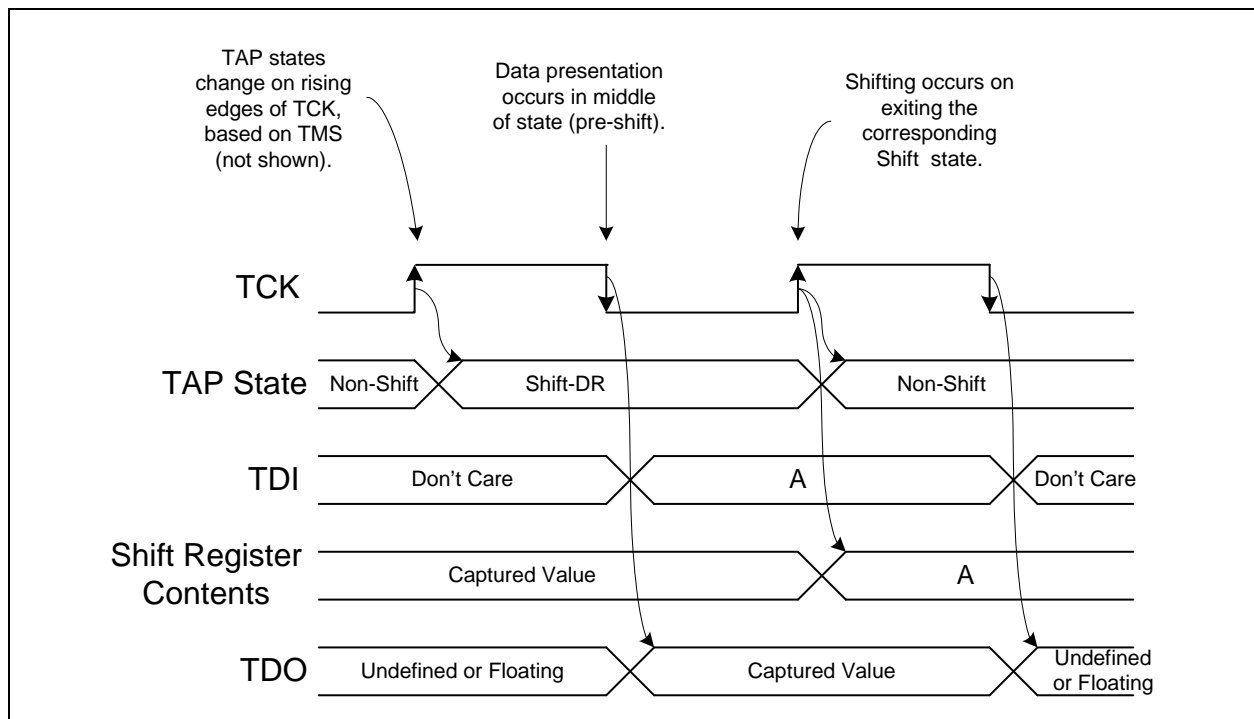
At the first falling edge of JTAG\_CLK, while the Shift-DR state is active, the TDO pin begins presenting the least-significant bit of the Shift Register (the only bit, in this example), which is holding the Captured Value. At about this time also, the external interface will drive TDI to the desired new state for this Data register.

At the next rising edge of JTAG\_CLK, the Shift-DR state is exited, and that same clock edge is used to actually perform the commanded shift. The TDI value "A" is shifted into the Shift Register. This same rising edge of JTAG\_CLK is used by the external interface to shift in the Captured Value from TDO. The TDO output does not change yet, because it is held by a 1/2 clock delay stage (see [FIGURE 20-1: on page 192](#)), providing hold time for the external interface.

On the next falling edge, the TDO output changes. Since the Shift state is no longer present, TDO is not required at this time to present valid data, and in fact for an off-chip connection it is required to float at this time.

After this timing diagram completes, the TAP machine will continue to an Update-DR state, at which time the value A, now present in the Shift Register, will be written to its destination. (In the specific case of the BYPASS register, there is no destination, and that step will do nothing.)

**FIGURE 20-3: TIMING ILLUSTRATION: 1-BIT DATA REGISTER**



## 20.5 Registers

### 20.5.1 INSTRUCTION REGISTER

The Instruction Register is four bits wide. It selects among the implemented Data Registers as listed in [Table 20-1](#). When the Tap Controller is placed into the Test-Logic-Reset state, the Instruction register is initialized to Ch, selecting the IDCODE Data Register.

Registers marked as MCHP reserved must not be modified. Modifications may lead to unpredictable and unwanted behavior.

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**TABLE 20-1: JTAG INSTRUCTION REGISTER ENCODINGS**

Instruction Register Contents	Data Register Selected	Function of Data Register	Width (Bits)	State on JTAG Reset (Hex)
0h	(Reserved: EXTEST)	Not implemented, but reserved as required by JTAG standard.	32	0000_0000h
1h	(Reserved: SAMPLE/PRELOAD)	Not implemented, but reserved as required by JTAG standard.	32	0000_0000h
2h	RESET TEST	<a href="#">RESET TEST Register (2h)</a>	32	0000_0000h
3h	TEST - MCHP Reserved	—	32	0000_0000h
4h	TEST - MCHP Reserved	—	32	0000_0000h
5h	(Reserved)	(Reserved for future use.)	32	0000_0000h
6h	(Reserved)	(Reserved for future use.)	32	0000_0000h
7h	(Reserved)	(Reserved for future use.)	32	0000_0000h
8h	TEST - MCHP Reserved	—	4	undefined (based on bus status)
9h	TEST - MCHP Reserved	—	4	3
Ah	TEST - MCHP Reserved	—	32	0000_0000h
Bh	TEST - MCHP Reserved	—	32	Out = 0000_0000h In = undefined
Ch	IDCODE	<a href="#">IDCODE Register (Ch)</a> JTAG Standard IDCODE Register (Capture = Read-Only fixed value)	32	1000_24B1h
Dh	TEST	<a href="#">TEST REGISTER 4 / Reset Register (Dh)</a>	32	0000_0000h
Eh	TEST - MCHP Reserved	—	32	0000_0000h
Fh	BYPASS	<a href="#">BYPASS Register (Fh)</a> JTAG Standard BYPASS Register (Capture = Read-Only '0')	1	0

## 20.5.2 JTAG STANDARD DATA REGISTERS

### 20.5.2.1 IDCODE Register (Ch)

This is a 32-bit read-only register containing the hex value 1000\_24B1. It serves to identify the ARC JTAG Port as belonging to an ARC600 core, in a component containing one processor.

IDCODE registers are required to conform to the JTAG standard, and they contain an 11-bit Manufacturer ID number.

**TABLE 20-2: IDCODE REGISTER**

INSTRUCTION REGISTER CONTENTS	32 bits						REGISTER SIZE	
Ch							1000_24B1h	
POWER	VTR						<a href="#">Async JTAG RESET</a> OR <a href="#">Sync JTAG RESET</a> DEFAULT	
BIT	BIT31	BIT30	BIT29	...	BIT2	BIT1	BIT0	
JTAG TYPE	R	R	R	R	R	R	R	
BIT NAME	IDCODE[31:0]							

## 20.5.2.2 BYPASS Register (Fh)

The BYPASS register consists only of a 1-bit shift register cell. The Capture-DR state clears it to '0' when selected. The Update-DR state does nothing.

The function of this register is to provide the minimum amount of delay (one bit of '0') when other JTAG ports on the chain are being exercised.

**TABLE 20-3: BYPASS REGISTER**

<b>INSTRUCTION REGISTER CONTENTS</b>	Fh		1 bit	<b>REGISTER SIZE</b>
<b>POWER</b>	VTR		1000_24B1h	Async JTAG RESET OR Sync JTAG RESET DEFAULT
<b>BIT</b>	<b>BIT0</b>			
<b>JTAG TYPE</b>				
<b>BIT NAME</b>	BYPASS			

## 20.5.3 JTAG TEST MODE DATA REGISTERS

JTAG Test Registers are 32-bit read/write registers that are used for test functions. These registers are always available to the JTAG port.

### 20.5.3.1 RESET TEST Register (2h)

The RESET TEST Register is a 32-bit register used to explicitly control reset functions inside the SCH5627P. The default for this register is 0000\_0000h.

**TABLE 20-4: RESET TEST REGISTER**

<b>INSTRUCTION REGISTER CONTENTS</b>	2h						32 bits	<b>REGISTER SIZE</b>	
<b>POWER</b>	VTR						0000_0000h	Async JTAG RESET DEFAULT	
<b>BIT</b>	<b>Bit 23</b>	<b>BIT22</b>	<b>BIT21</b>	<b>BIT20</b>	<b>BIT19</b>	<b>BIT18</b>	<b>BIT17</b>	<b>BIT16</b>	
<b>JTAG TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
<b>BIT NAME</b>	Test			Test			Test		
<b>BIT</b>	<b>BIT 15</b>	<b>BIT 14</b>	<b>BIT 13</b>	<b>BIT 12</b>	<b>BIT 11</b>	<b>BIT 10</b>	<b>BIT 9</b>	<b>BIT 8</b>	
<b>JTAG TYPE</b>	R/W	R/W	R/W	R	R	R	R/W	R/W	
<b>BIT NAME</b>	Test	Test	Test	Test	Test	Test	Test	Test	
<b>BIT</b>	<b>BIT 7</b>	<b>BIT 6</b>	<b>BIT 5</b>	<b>BIT 4</b>	<b>BIT 3</b>	<b>BIT 2</b>	<b>BIT 1</b>	<b>BIT 0</b>	
<b>JTAG TYPE</b>	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/	
<b>BIT NAME</b>	Test	Test	Test	Test	POR EN	VTR POR	VCC RESET	Res	

## VCC RESET

Assert VCC RESET. If this bit is '0' while the field **POR EN** in this register is '1', a VCC RESET is forced. If this bit is '1', the VCC RESET circuitry returns to its normal state.

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## VTR POR

Asserts VTR Power On Reset: When the **VTR POR** active low bit is asserted '0' while the field **POR EN** in this register is '1', forces a VTR Power On Reset. When the **VTR POR** active low bit de-asserted '1', the VCC POR circuitry returns to its normal state.

## POR EN

Power On Reset Enable. When '1', the reset functions controlled by **VCC RESET** and **VTR POR** are enabled. When '0', the **VCC RESET** and **VTR POR** fields in this register have no effect on the POR circuitry.

## TEST

All TEST bits should be set to '0' when writing this register.

### 20.5.3.2 TEST REGISTER 4 / Reset Register (Dh)

The RESET TEST Register is a 32-bit register used to explicitly control reset functions inside the SCH5627P. The default for this register is 0000\_0000h.

**TABLE 20-5: TEST REGISTER 4 / RESET REGISTER**

INSTRUCTION REGISTER CONTENTS	Dh						32 bits		REGISTER SIZE
POWER	VTR						0000_0000h		Async JTAG RESET DEFAULT
BIT	BIT31	BIT30	BIT29	BIT28	BIT27	BIT26	BIT25	BIT24	
JTAG TYPE	R	R	R	R	R	R	R	R	
BIT NAME	Test	Test	Res	Test	Res	Res	Res	Test	
BIT	BIT23	BIT22	BIT21	BIT20	BIT19	BIT18	BIT17	BIT16	
JTAG TYPE	R	R	R/W	R/W	R/W	R/W	R/W	R/W	
BIT NAME	Test	Test	Test	Test	Test	Test	Test	Test	
BIT	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	
JTAG TYPE	R/W	R/W	R	R	R/W	R/W	R/W	R/W	
BIT NAME	Test	Test	Test	Test	Test	Test			
BIT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
JTAG TYPE	R	R	R	R/W	R/W	R/W	R/W	R/W	
BIT NAME	Test	Test	Test	Test	Test	Test	Test_XNOR_En	ARC_Fast_Reset	

### ARC\_Fast\_Reset

If this bit is '1b', the reset going to the ARC processor and select peripherals is reduced from its nominal 20ms duration. If this bit is '0b', the ARC reset is stretched by the nominal delay.

### Test\_XNOR\_En

If this bit is '1b', the Device-Under-Test XNOR chain test mode is enabled. If this bit is '0b', the XNOR mode is disabled. See [Section 41.12, "XNOR Chain," on page 682](#).

**Note:** Once the XNOR chain is enabled, a power cycle is required to re-establish JTAG operation.

## 20.6 JTAG Standard Port Discovery

This section provides information that is not unique to ARC, but is part of the JTAG standard, and is provided for information.

The Discovery process will identify each JTAG controller that has an IDCODE register. Part of what needs to be derived is the length of the Instruction register in each of the JTAG ports. If this cannot be derived from the IDCODE values, or if some JTAG ports do not have an IDCODE register, then the missing lengths must be provided by other means.

In the Test-Logic-Reset state, a JTAG port is required to initialize its Instruction register to select the IDCODE Data register if present, or if it is not present, then to select the BYPASS Data register.

The IDCODE Data register:

- Must be exactly 32 bits in length
- Must have '1' in its first (least-significant) bit
- Must not have the pattern 000011111111 (FFh) in its first (least-significant) 12 bits.
- Will contain a completely definitive port identification, because 11 bits of it are a Manufacturer ID number assigned by the JEDEC standards organization.

A BYPASS Data register access will initialize its 1-bit shift register to '0' at the Capture-DR state, effectively making the BYPASS register appear to be 1-bit read-only '0'.

Discovery, therefore, consists of the external JTAG host doing the following:

- Place the chain of JTAG controllers into the Test-Logic-Reset state.
- Do a Data register access, without an Instruction register access first.
  - This Data access will shift in 8 bits of ones, followed by all zeroes for the duration of the discovery phase.
- While shifting, examine the data appearing on TDO for IDCODE values.
  - A '0' indicates a JTAG port that has no IDCODE register. Collect only this bit, and note that the JTAG port exists. Start looking for an IDCODE value at the next bit.
  - A '1' indicates that an IDCODE register is coming. Collect this bit and the next 31 bits to identify the JTAG port. If, however, the value seen is 00h0000FF, then this is maintained to be the value provided originally on TDI, and indicates the end of the chain.

## 20.7 XNOR Chain

### 20.7.1 OVERVIEW

The [XNOR Chain](#) test mode allows users to confirm that all SCH5627P pins are in contact with the motherboard during assembly and test operations. The [XNOR Chain](#) test mode is enabled and disabled through the JTAG interface, using bit [Test\\_XNOR\\_En](#) in JTAG [TEST REGISTER 4 / Reset Register \(Dh\)](#).

An example of an [XNOR Chain](#) test structure is illustrated below in [Figure 20-4](#). When the [XNOR Chain](#) test mode is enabled all pins except for the [Excluded Pins](#) shown in [Section 20.7.2](#) are disconnected from their internal functions and forced as inputs to the [XNOR Chain](#). This allows a single input pin to toggle the [XNOR Chain](#) output if all other input pins are held high or low. The [XNOR Chain](#) output is the GP031 pin.

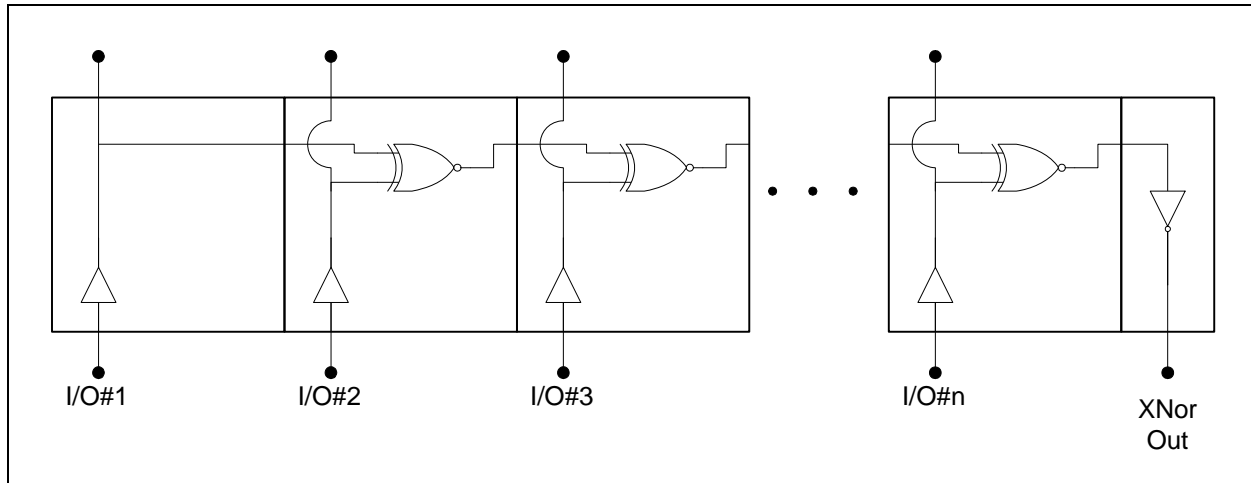
The tests that are performed when the [XNOR Chain](#) test mode is enabled require the board-level test hardware to control the device pins and observe the results at the [XNOR Chain](#) output pin; e.g., as described in [Section 20.7.3, "Test Procedure," on page 200](#).

### 20.7.2 EXCLUDED PINS

The following pins are [XNOR Chain Excluded Pins](#):

- POWER PLANE pins, VR\_CAP, PECl  $V_{REF}$
- TRST#.
- Analog pins: REMOTE1-, REMOTE1+, REMOTE2-, REMOTE2+, V\_IN

FIGURE 20-4: XNOR CHAIN TEST STRUCTURE



## 20.7.3 TEST PROCEDURE

### 20.7.3.1 Setup

1. Connect the VSS and AGND pins to ground.
2. Connect the VCC0, VCC1, and VCC2 pins to an unpowered 3.3V power source.
3. Connect an oscilloscope or voltmeter to the GP031 pin.
4. All other pins should be tied to ground.

**Warning:** Ensure power supply is off during Setup.

### 20.7.3.2 Testing

1. Turn on the 3.3V power source.
2. Enable the XNOR Chain through the JTAG interface (`Test_XNOR_En` in JTAG TEST REGISTER 4 / Reset Register (Dh)). Note that at this point all inputs to the XNOR Chain are low and the output on the GP031 pin is high (refer to the Initial Configuration row in Table 20-6, "Toggling Inputs in Descending Pin Order").
3. Bring the highest numbered pin (N) high, where N is the number of pins to be tested as described in Note 20-1. The output on the GP031 pin should toggle (refer to Step 1 in Table 20-6).
4. In descending pin order successively bring each input high. As shown in Table 20-6 the GP031 pin toggles after each step. Continue until all inputs are high. The output on the GP031 pin is high (refer to the Final Configuration in Table 20-6).
5. The current state of the chip is now represented by the Initial Configuration row in Table 20-7, "Toggling Inputs in Ascending Pin Order".
6. Each input should now be brought low, starting at pin one (Step N+1) and continuing in ascending pin order until all inputs are low. The output on the GP031 pin is high (refer to the Final Configuration in Table 20-7).
7. Exit the XNOR Chain Test Mode by cycling VTR power.



**TABLE 20-6: TOGGLING INPUTS IN DESCENDING PIN ORDER**

	Pin Number (Note 20-1)							GP031
	N	N - 1	N - 2	N - 3	N - 4	...	1	
Initial Configuration	L	L	L	L	L	L	L	H
Step 1	H	L	L	L	L	L	L	L
Step 2	H	H	L	L	L	L	L	H
Step 3	H	H	H	L	L	L	L	L
Step 4	H	H	H	H	L	L	L	H
Step 5	H	H	H	H	H	L	L	L
...	H	H	H	H	H	...	L	...
Step N-1	H	H	H	H	H	H	L	L
Final Configuration	H	H	H	H	H	H	H	H

**TABLE 20-7: TOGGLING INPUTS IN ASCENDING PIN ORDER**

	Pin Number (Note 20-1)							GP031
	1	2	3	4	5	...	N	
Initial Configuration	H	H	H	H	H	H	H	H
Step N+1	L	H	H	H	H	H	H	L
Step N+2	L	L	H	H	H	H	H	H
Step N+3	L	L	L	H	H	H	H	L
Step N+4	L	L	L	L	H	H	H	H
Step N+5	L	L	L	L	L	H	H	L
...	L	L	L	L	L	...	H	...
Step N+(N-1)	L	L	L	L	L	L	H	L
Final Configuration	L	L	L	L	L	L	L	H

**Note 20-1** pin numbers in these tables represent the number of pins to be tested and do not include the pins listed in [Section 20.7.2, "Excluded Pins,"](#) on page 199.

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## 21.0 ELECTRICAL SPECIFICATIONS

### 21.1 Maximum Ratings\*

Operating Temperature Range ..... 0°C to +70°C  
 Storage Temperature Range ..... -55° to +150°C  
 Lead Temperature Range ..... Refer to JEDEC Spec J-STD-020B  
 Positive Voltage on any pin, with respect to Ground ..... +5.5V  
 Negative Voltage on any pin, with respect to Ground ..... -0.3V  
 Supply Voltage Range  $V_{vtr}$  ..... 3.6 VDC

\*Stresses above those listed above could cause permanent damage to the device. This is a stress rating only and functional operation of the device at any other condition above those indicated in the operation sections of this specification is not implied.

**Note:** When powering this device from laboratory or system power supplies, it is important that the Absolute Maximum Ratings not be exceeded or device failure can result. Some power supplies exhibit voltage spikes on their outputs when the AC power is switched on or off. In addition, voltage transients on the AC power line may appear on the DC output. If this possibility exists, it is suggested that a clamp circuit be used.

**TABLE 21-1: OPERATING CONDITIONS**

Symbol	Parameter	MIN	TYP	MAX	Units
VBAT	Battery Backup Supply	2.0	3.0	3.6	V
VTR	Main Supply	2.97	3.3	3.63	V
PCI_CLK	PCI Clock		33		MHz
$T_A$	Operating Temperature	0		70	°C

#### 21.1.1 HWM MAXIMUM RATINGS

Operating Temperature Range ..... 0°C to +70°C  
 Storage Temperature Range ..... -55°C to +150°C  
 Maximum avdd ..... +4V  
 Voltage on RTF<7:1>, RTS<7:1>, RTP<7:1>, RTM<7:1>, Diode Pins ..... avdd + 0.3V  
 Minimum Voltage on any Pin ..... -0.3V

**Note:** Stresses above those listed could cause permanent damage to the device. This is a stress rating only and functional operation of the device at or above those listed in the operating sections of this specification are not implied or tested. When powering this device from liberator or test equipment, it is important that these Absolute Maximum ratings not be exceeded or device failure may result.

## 21.2 DC Specifications

### 21.2.1 ELECTRICAL CHARACTERISTICS

**TABLE 21-2: DC ELECTRICAL CHARACTERISTICS**

( $T_A = 0^\circ\text{C} - 70^\circ\text{C}$ ,  $V_{TR} = 3.3\text{ VDC} \pm 10\%$ )

Buffer types that are 5V tolerant are listed in [Table 3-1, "Signal Descriptions,"](#) on page 11.

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
I Type Input Buffer						
Low Input Level	$V_{ILI}$			0.8	V	TTL Levels
High Input Level	$V_{IHI}$	2.0			V	
I <sub>M</sub> Type Input Buffer						
Low Input Level	$V_{ILI}$			0.8	V	TTL Levels
High Input Level	$V_{IHI}$	2.0			V	
O4 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 4\text{ mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -4\text{ mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
OD4 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$V_{OL} = 4\text{ mA}$
Output Leakage	$I_{OH}$	-10		+10	$\mu\text{A}$	$I_{OH} = 0\text{ to }V_{TR}$
O8 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 8\text{ mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -8\text{ mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
OD8 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$V_{OL} = 8\text{ mA}$
Output Leakage	$I_{OH}$	-10		+10	$\mu\text{A}$	$I_{OH} = 0\text{ to }V_{TR}$
O12 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 12\text{mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -12\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
OD12 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 12\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
OD16 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 16\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$

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**TABLE 21-2: DC ELECTRICAL CHARACTERISTICS (CONTINUED)**

( $T_A = 0^\circ\text{C} - 70^\circ\text{C}$ ,  $V_{TR} = 3.3\text{ VDC} \pm 10\%$ )

Buffer types that are 5V tolerant are listed in [Table 3-1, "Signal Descriptions,"](#) on page 11.

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
IO4 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 4\text{mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -4\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
IOD4 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 4\text{ mA}$
High Input Level	$V_{IH}$	2.0			V	
Low Input Level	$V_{IL}$			0.8	V	
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
IO8 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 8\text{mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -8\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
IOD8 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 8\text{ mA}$
High Input Level	$V_{IH}$	2.0			V	
Low Input Level	$V_{IL}$			0.8	V	
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
IO12 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 12\text{mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -12\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
IOD12 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 12\text{mA}$
High Input Level	$V_{IH}$	2.0			V	
Low Input Level	$V_{IL}$			0.8	V	
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0\text{ to }V_{TR}$
IOP14 Type Buffer						
High Input Level	$V_{IH}$	2.0			V	$I_{OL} = 14\text{mA}$
Low Input Level	$V_{IL}$			0.8	V	$I_{OH} = -14\text{mA}$
Low Output Level	$V_{OL}$	2.4		0.4	V	$V_{IN} = 0\text{ to }V_{TR}$
High Output Level	$V_{OH}$	-10			$\mu\text{A}$	
Output Leakage	$I_{OL}$			+10		

**TABLE 21-2: DC ELECTRICAL CHARACTERISTICS (CONTINUED)**

( $T_A = 0^\circ\text{C} - 70^\circ\text{C}$ ,  $V_{TR} = 3.3\text{ VDC} \pm 10\%$ )

Buffer types that are 5V tolerant are listed in [Table 3-1, "Signal Descriptions,"](#) on page 11.

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
IO16 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 16\text{mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -16\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0$ to $V_{TR}$
IOD16 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 16\text{ mA}$
High Input Level	$V_{IH}$	2.0			V	
Low Input Level	$V_{IL}$			0.8	V	
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0$ to $V_{TR}$
IO24 Type Buffer						
Low Output Level	$V_{OL}$			0.4	V	$I_{OL} = 24\text{mA}$
High Output Level	$V_{OH}$	2.4			V	$I_{OH} = -24\text{mA}$
Output Leakage	$I_{OL}$	-10		+10	$\mu\text{A}$	$V_{IN} = 0$ to $V_{TR}$
PCI_CLK Type Buffer	PCI_ICLK					See <i>PCI Local Bus Specification Rev. 2.2</i>
PCI_IO Type Buffers	PCI_IO PCI_O PCI_I					
PCI_OD Type Buffer	PCI_OD					
PROCHOT I Buffer (PECI_I)						All input and output voltages are a function of VREF buffer input.
Input voltage range	$V_{In}$	-0.3		$V_{REF} + 0.3$	V	
Low Input Level	$V_{IL}$			$0.275 \times V_{REF}$	V	
High Input Level	$V_{IH}$	$0.725 \times V_{REF}$			V	
PECI_IO						All input and output voltages are a function of VREF buffer input. See Peci Specification.
Input voltage range	$V_{In}$	-0.3		$V_{REF} + 0.3$	V	
Hysteresis	$V_{HYS}$	$0.1 \times V_{REF}$	$0.2 \times V_{REF}$		V	
Low Input VLevel	$V_{IL}$			$0.275 \times V_{REF}$	V	
High Input Level	$V_{IH}$	$0.725 \times V_{REF}$			V	
Low Output Level	$V_{OL}$			$0.25 \times V_{REF}$	V	
High Output Level	$V_{OH}$	$0.75 \times V_{REF}$			V	
						$0.5\text{mA} < I_{OL} < 1\text{mA}$
						$I_{OH} = -6\text{mA}$

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**TABLE 21-2: DC ELECTRICAL CHARACTERISTICS (CONTINUED)**

( $T_A = 0^\circ\text{C} - 70^\circ\text{C}$ ,  $V_{TR} = 3.3\text{ VDC} \pm 10\%$ )

Buffer types that are 5V tolerant are listed in [Table 3-1, "Signal Descriptions,"](#) on page 11.

Parameter	Symbol	MIN	TYP	MAX	Units	Comments
$V_{REF}$ Buffer Input Voltage, PECl	VI	0.95		1.26	V	Connects to VTT Processor dependent
Input Voltage, AMD- $T_{SI_{DDR2}}$		1.7		1.9	V	
Input Voltage, AMD- $T_{SI_{DDR3}}$		1.42		1.575	V	
Input current	IDC			100	$\mu\text{A}$	
Input Low Current	ILEAK	-10		+10	$\mu\text{A}$	
OD_PH Type Buffer (PROCHOT#)						
Low Output Level	$V_{OL}$			0.3	V	$I_{OL} = 23\text{mA}$
High Output Level	$V_{OH}$		$V_{REF}$		V	Open Drain, $V_{REF} = 1.2\text{V}$

**Note 21-1** All 5V Tolerant I-type & I/O-type input buffers can be pulled to 5 volts.

**Note 21-2** All 5V Tolerant OD-type output buffers can be pulled to 5 volts.

**Note 21-3** All 5V Tolerant O-type and I/O-type output buffers will only drive to 3.3 volts, even if pulled-up externally to 5 volts.

## 21.3 Power Consumption

**TABLE 21-3: SCH5627P POWER CONSUMPTION**

$V_{CC}$	$v_{TR}$	System "S" State	EC State	Clock State	Supply Current			Comments
						Typical (25 <sup>o</sup> C)	MAX (70 <sup>o</sup> C)	
3.3V	3.3V	S0-S2	Run	Ring OSC @ 64 MHz	VTR	15mA	22mA	
0V		S3	Run		VTR	11mA	17mA	
		Extreme Low S5	Off	None	VTR	1ma	3ma	
	0V	S5	Off	None	VBAT	2.5 $\mu\text{A}$	4.5 $\mu\text{A}$ (@25 <sup>o</sup> C)	$2.0\text{V} < V_{bat} < 3.0\text{V}$

## 21.4 AC Specifications

AC Test Conditions

CAPACITANCE  $T_A = 25^\circ\text{C}$ ;  $f_c = 1\text{MHz}$ ;  $V_{CC} = 3.3\text{ VDC}$

Parameter	Symbol	Limits			Units	Test Condition
		MIN	TYP	MAX		
Clock Input Capacitance	$C_{IN}$			20	pF	All pins except pin under test tied to AC ground
Input Capacitance	$C_{IN}$			10	pF	
Output Capacitance	$C_{OUT}$			20	pF	

## 21.5 HWM Operating Specifications

**TABLE 21-4: HWM ELECTRICAL SPECIFICATIONS**

T <sub>A</sub> = 0°C to +70°C, AVDD = 3.3V ± 10%, VDDD = 1.2V ± 10% Unless Otherwise Specified							
Parameter	Symbol	Min.	Typ	Max	Units	Conditions	Notes
<b>ADC (General)</b>							
Resolution			11		bit		
<b>Temperature Conversion</b>							
Internal Diode Accuracy			0.5	<±2	°C	-10°C < T <sub>A</sub> < 125°C	
Internal Diode Resolution			0.125		°C		
External Diode Accuracy			0.25	±1	°C	60°C < T <sub>DIODE</sub> < 100°C, 0°C < T <sub>A</sub> < 125°C	
				±3	°C	-64°C < T <sub>DIODE</sub> < 191°C	
External Diode Resolution			0.0625		°C	12-bit conversion	
Series Resistance Error Correction	R <sub>SERIES</sub>			100	Ohm	Total series with diode lines to block including parasitic routing impedance	
Capacitive Load	C <sub>LOAD</sub>		2.2	2.5	nF	Connected across external diodes.	<a href="#">Note 21-5</a>

**Note 21-4** The nature of the ADC implies that the Full Scale voltage is equal to V<sub>REF</sub> - 1 LSB or, V<sub>REF</sub> \* 2047 / 2048.

**Note 21-5** The Capacitive Load will be dependent on the beta of the transistor being measured. The given value is for a beta greater or equal to 0.4. If the beta is less than 0.4, then the supported value is reduced. The current IP can support up to 10nF for a diode-connected transistor.

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## 22.0 TIMING DIAGRAMS

### 22.1 LPC Clock and Reset Timing

FIGURE 22-1: PCI CLOCK TIMING

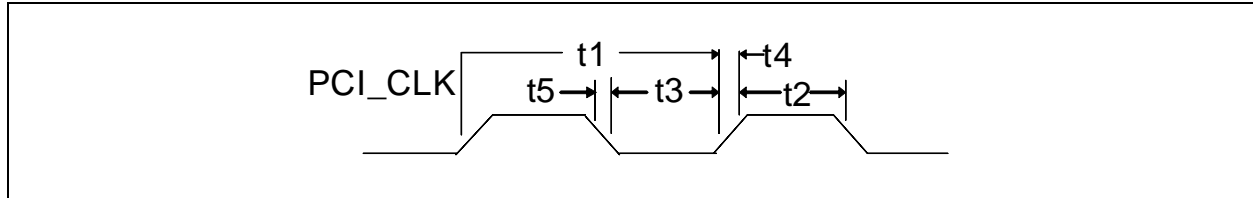


TABLE 22-1: PCI CLOCK TIMING PARAMETERS

Name	Description	MIN	TYP	MAX	Units
t1	Period	30		33.3	nsec
t2	High Time	11			
t3	Low Time				
t4	Rise Time			3	
t5	Fall Time				

FIGURE 22-2: RESET TIMING

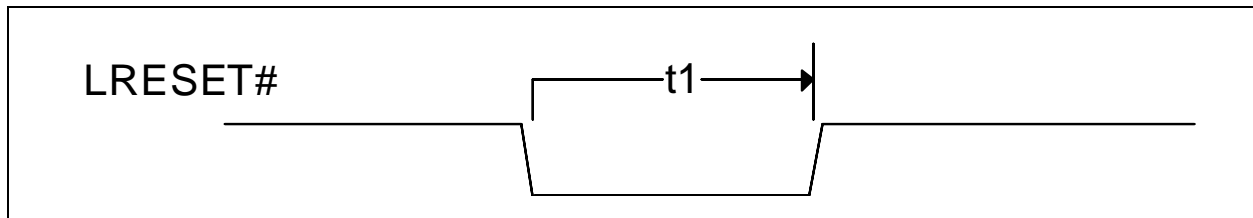


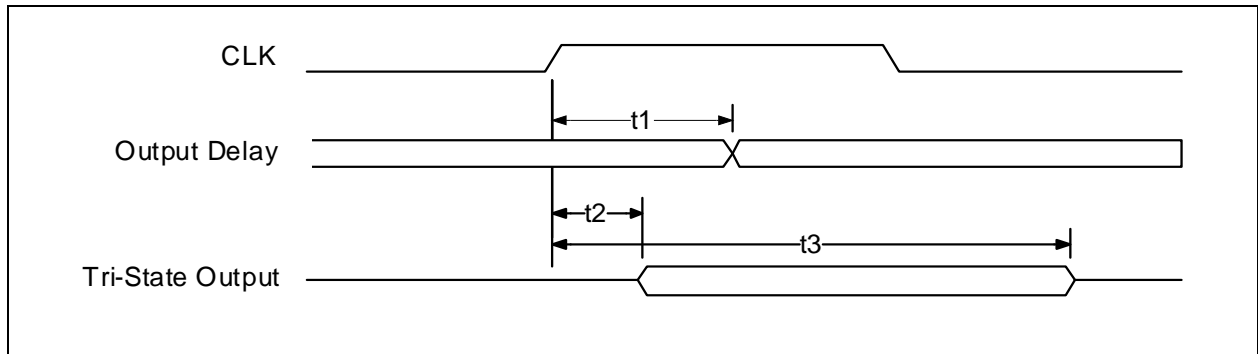
TABLE 22-2: RESET TIMING PARAMETERS

Name	Description	MIN	TYP	MAX	Units
t1	LRESET# width	1			ms



## 22.2 LPC Bus Timing

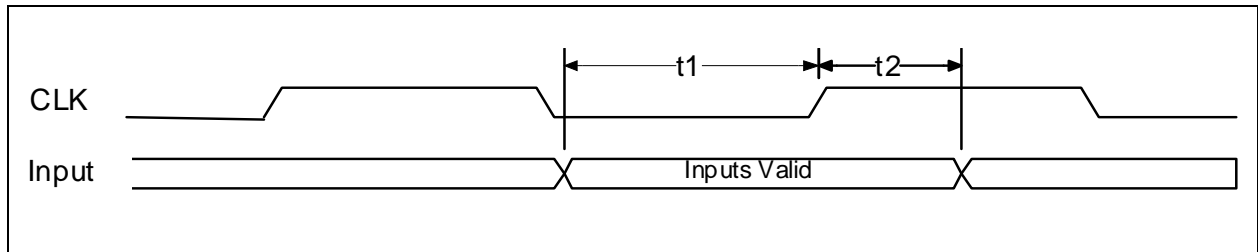
**FIGURE 22-3: OUTPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS**



**TABLE 22-3: OUTPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	CLK to Signal Valid Delay – Bused Signals	2		11	ns
t2	Float to Active Delay				
t3	Active to Float Delay			28	

**FIGURE 22-4: INPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS**

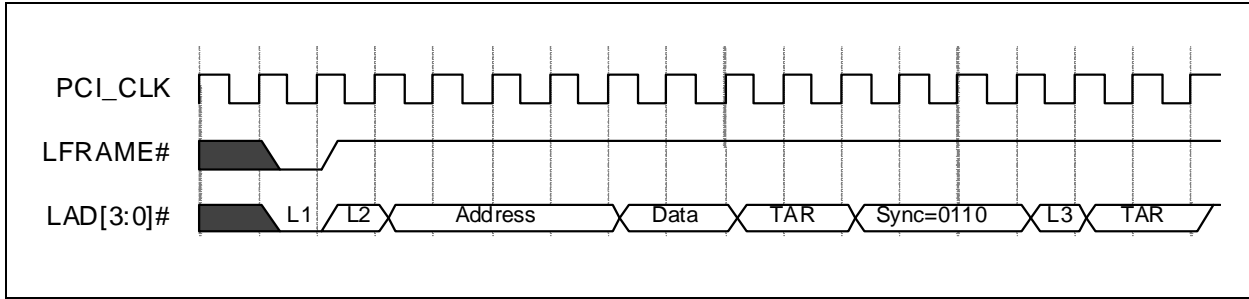


**TABLE 22-4: INPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	Input Set Up Time to CLK – Bused Signals	7			ns
t2	Input Hold Time from CLK				

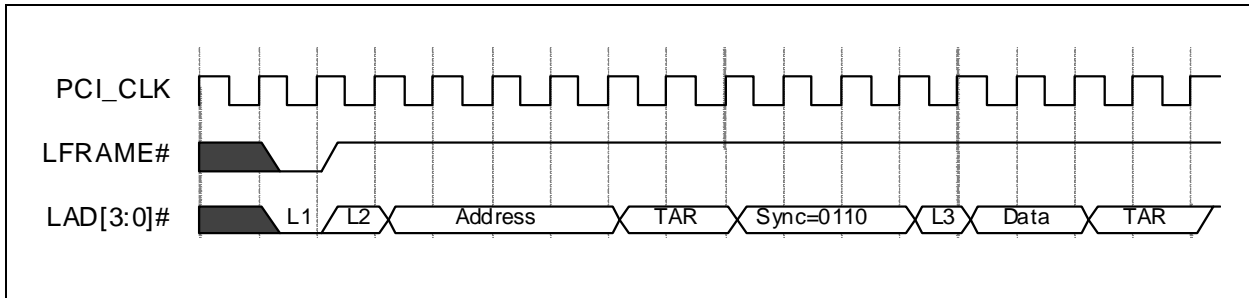
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**FIGURE 22-5: I/O WRITE**



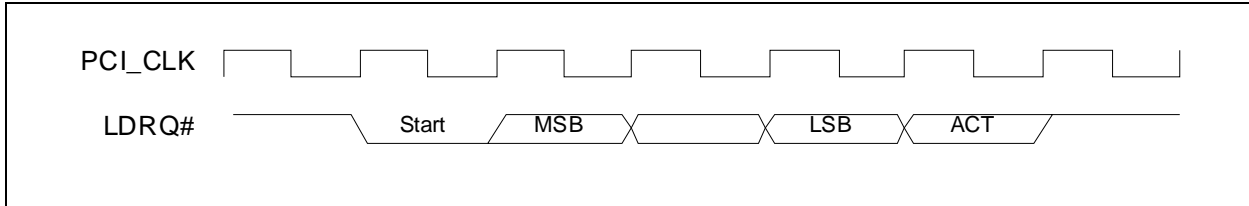
**Note:** L1=Start; L2=CYCTYP+DIR; L3=Sync of 0000

**FIGURE 22-6: I/O READ**

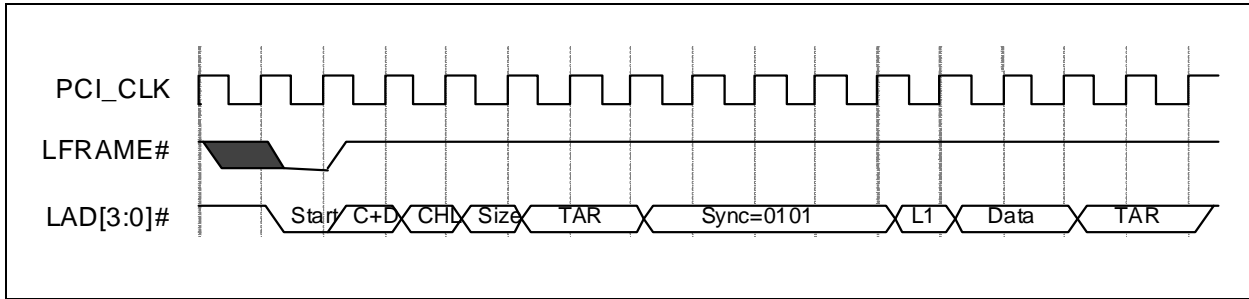


**Note:** L1=Start; L2=CYCTYP+DIR; L3=Sync of 0000

**FIGURE 22-7: DMA Request Assertion Through LDRQ#**

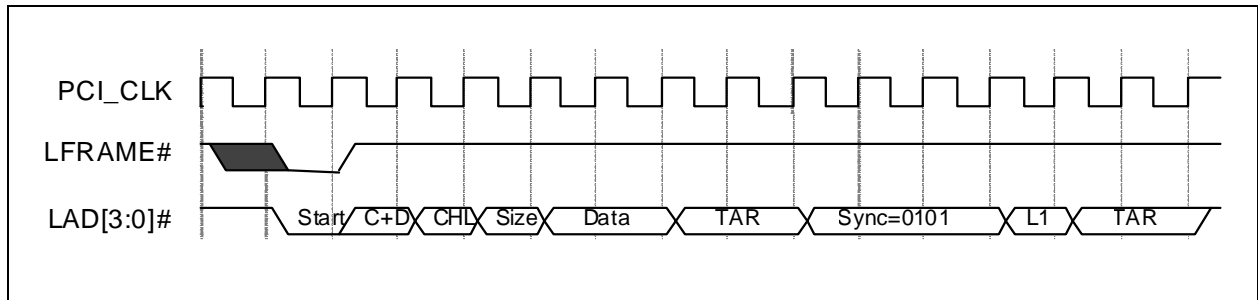


**FIGURE 22-8: DMA Write (First Byte)**



**Note:** L1=Sync of 0000

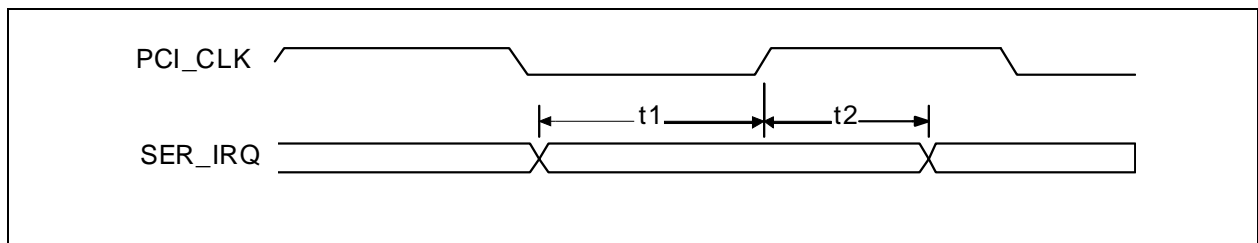
**FIGURE 22-9: DMA READ (FIRST BYTE)**



**Note:** L1=Sync of 0000

## 22.3 Serial IRQ Timing

**FIGURE 22-10: SETUP AND HOLD TIME**



**TABLE 22-5: SETUP AND HOLD TIME**

Name	Description	MIN	TYP	MAX	Units
t1	SER_IRQ Setup Time to PCI_CLK Rising	7			nsec
t2	SER_IRQ Hold Time to PCI_CLK Rising	0			

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## 22.4 Floppy Disk Controller Timings

FIGURE 22-11: FLOPPY DISK DRIVE TIMING (AT MODE ONLY)

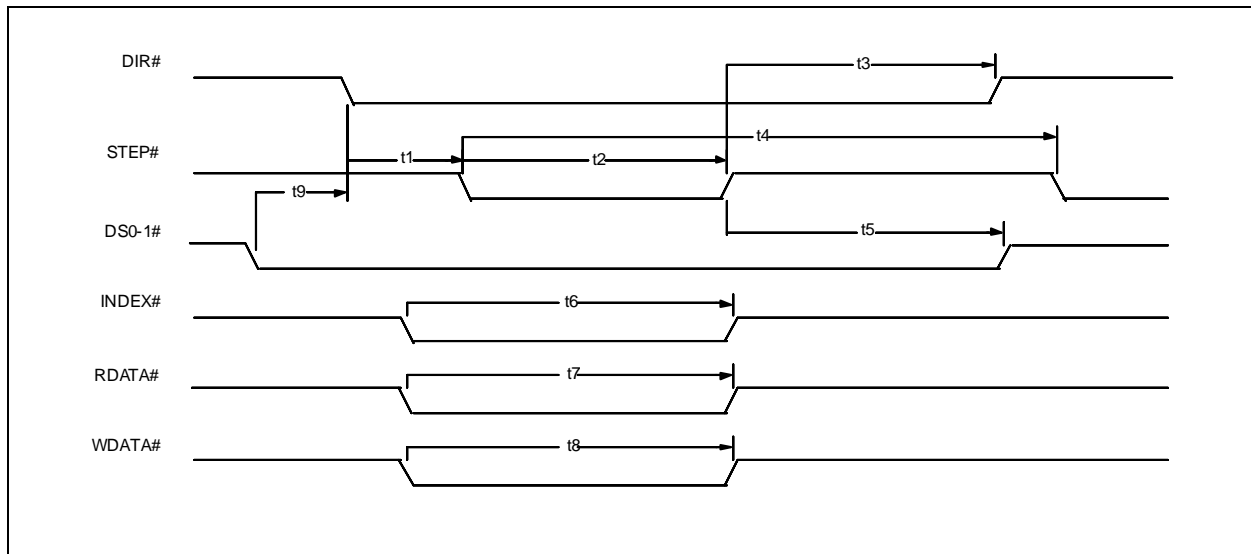


TABLE 22-6: FLOPPY DISK DRIVE TIMING (AT MODE ONLY) PARAMETERS

Name	Description	MIN	TYP	MAX	Units
t1	DIR# Set Up to STEP Low		4		X*
t2	STEP# Active Time Low		24		X*
t3	DIR# Hold Time after STEP#		96		X*
t4	STEP# Cycle Time		132		X*
t5	DS0# & DS1# Hold Time from STEP# Low (Note)		20		X*
t6	INDEX# Pulse Width		2		X*
t7	RDATA# Active Time Low		40		ns
t8	WDATA# Write Data Width Low		.5		Y*
t9	DS0# & DS1#, Setup Time DIR# Low (Note)	0			ns

\*X specifies one MCLK period and Y specifies one WCLK period.

MCLK = 16 x Data Rate (at 500 kb/s MCLK = 8 MHz)

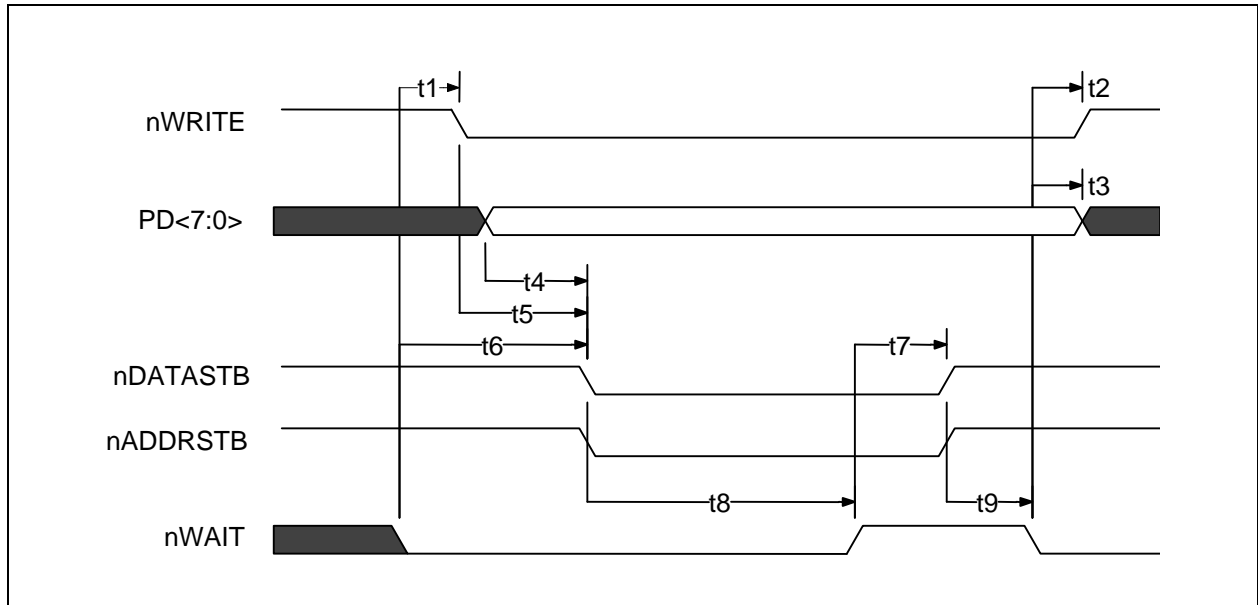
WCLK = 2 x Data Rate (at 500 kb/s WCLK = 1 MHz)

**Note:** The DS0 & DS1 setup and hold times must be met by software.

## 22.5 Parallel Port Timings

### 22.5.1 EPP PARALLEL PORT TIMINGS

**FIGURE 22-12: EPP 1.9 Data or Address Write Cycle**



**TABLE 22-7: EPP 1.9 DATA OR ADDRESS WRITE CYCLE PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	nWAIT Asserted to nWRITE Asserted (See Note)	60		185	ns
t2	nWAIT Asserted to nWRITE Change (See Note)	60		185	ns
t3	nWAIT Asserted to PDATA Invalid (See Note)	0			ns
t4	PDATA Valid to Command Asserted	10			ns
t5	nWRITE to Command Asserted	5		35	ns
t6	nWAIT Asserted to Command Asserted (See Note 22-1)	60		210	ns
t7	nWAIT Deasserted to Command Deasserted (See Note 22-1)	60		190	ns
t8	Command Asserted to nWAIT Deasserted	0		10	μs
t9	Command Deasserted to nWAIT Asserted	0			ns

**Note 22-1** nWAIT must be filtered to compensate for ringing on the parallel bus cable. nWAIT is considered to have settled after it does not transition for a minimum of 50 nsec.

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FIGURE 22-13: EPP 1.9 Data or Address Read Cycle

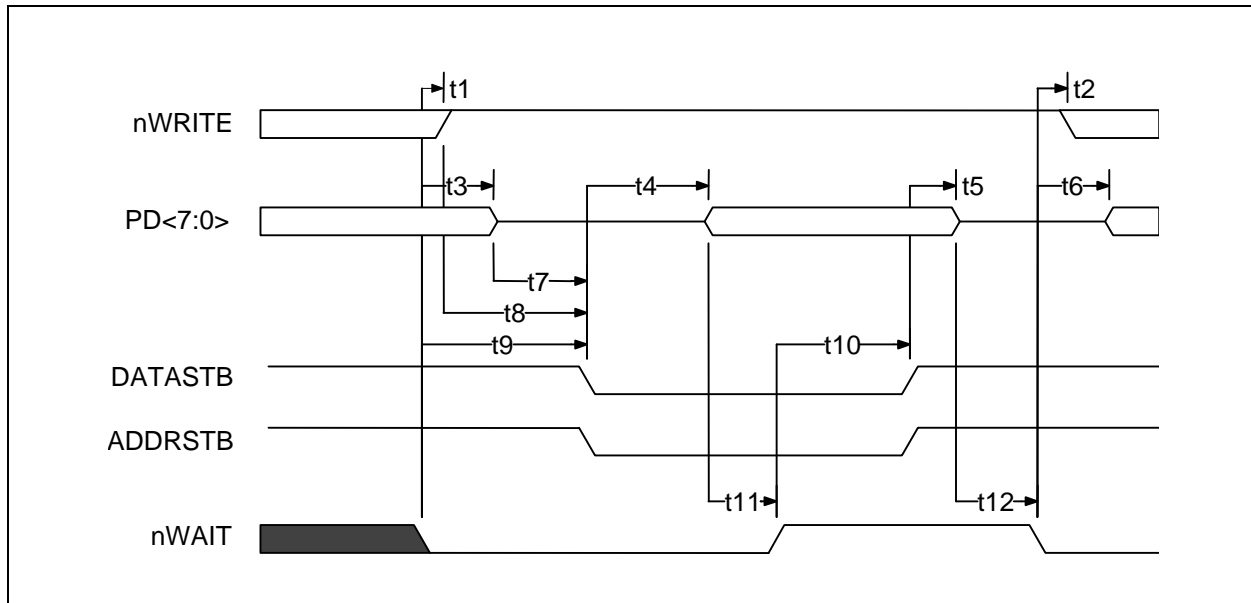


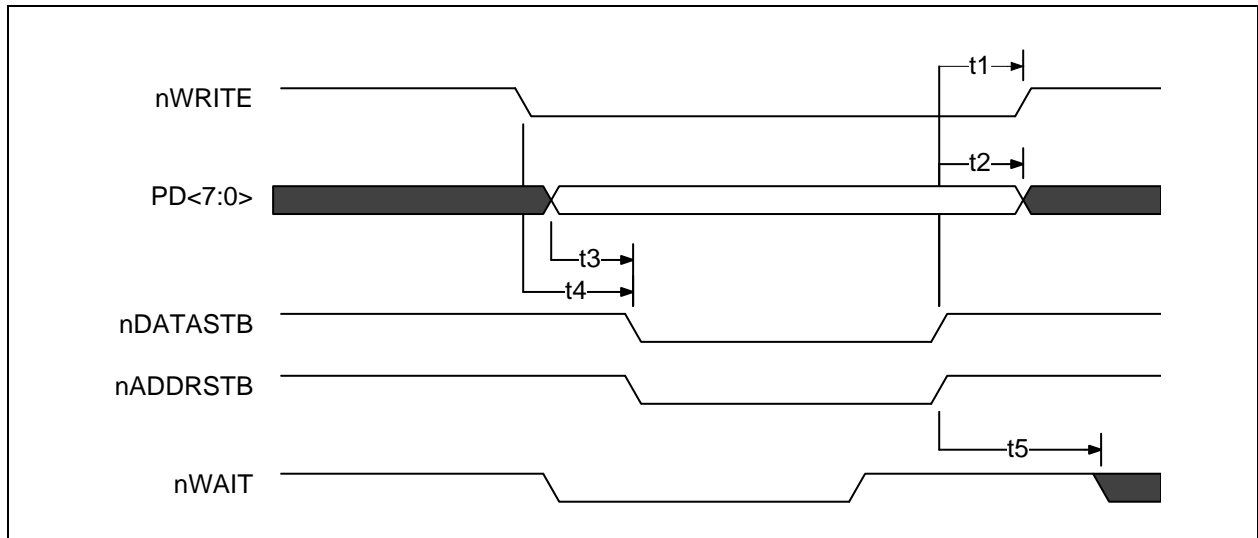
TABLE 22-8: EPP 1.9 DATA OR ADDRESS READ CYCLE

Name	Description	MIN	TYP	MAX	Units
t1	nWAIT Asserted to nWRITE Deasserted	0		185	ns
t2	nWAIT Asserted to nWRITE Modified (Note 22-1, Note 22-2)	60		190	ns
t3	nWAIT Asserted to PDATA Hi-Z (Note 22-1)	60		180	ns
t4	Command Asserted to PDATA Valid	0			ns
t5	Command Deasserted to PDATA Hi-Z	0			ns
t6	nWAIT Asserted to PDATA Driven (Note 22-1)	60		190	ns
t7	PDATA Hi-Z to Command Asserted	0		30	ns
t8	nWRITE Deasserted to Command	1			ns
t9	nWAIT Asserted to Command Asserted	0		195	ns
t10	nWAIT Deasserted to Command Deasserted (Note 22-1)	60		180	ns
t11	PDATA Valid to nWAIT Deasserted	0			ns
t12	PDATA Hi-Z to nWAIT Asserted	0			μs

**Note 22-1** nWAIT is considered to have settled after it does not transition for a minimum of 50 ns.

**Note 22-2** When not executing a write cycle, EPP nWRITE is inactive high.

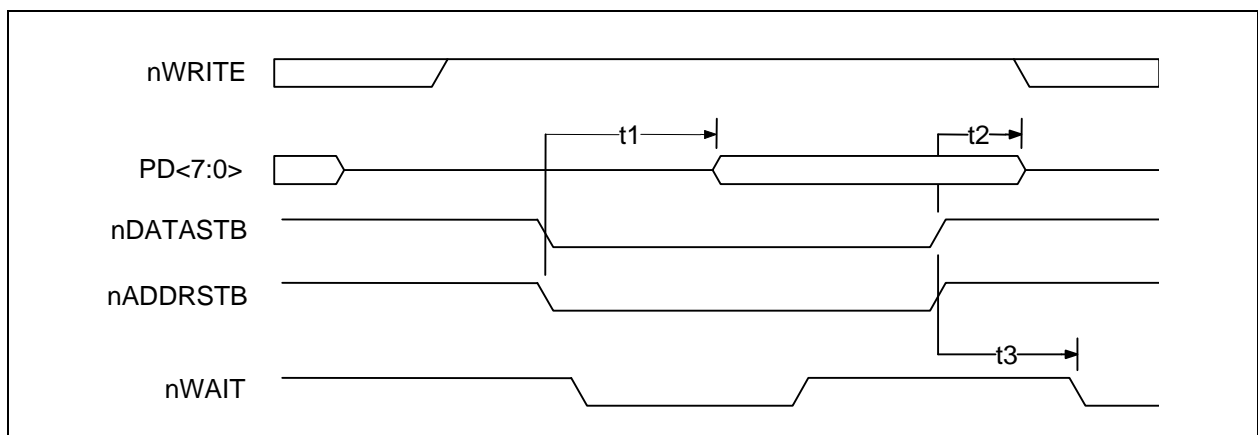
**FIGURE 22-14: EPP 1.7 Data or Address Write Cycle**



**TABLE 22-9: EPP 1.7 DATA OR ADDRESS WRITE CYCLE**

Name	Description	MIN	TYP	MAX	Units
t1	Command Deasserted to nWRITE Change	0		40	ns
t2	Command Deasserted to PDATA Invalid	50			ns
t3	PDATA Valid to Command Asserted	10		35	ns
t4	nWRITE to Command	5		35	ns
t5	Command Deasserted to nWAIT Deasserted	0			ns

**FIGURE 22-15: EPP 1.7 Data or Address Read Cycle**



**TABLE 22-10: EPP 1.7 DATA OR ADDRESS READ CYCLE PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	Command Asserted to PDATA Valid	0			ns
t2	Command Deasserted to PDATA Hi-Z	0			ns
t3	Command Deasserted to nWAIT Deasserted	0			ns

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---

## 22.5.2 ECP PARALLEL PORT TIMING

### Parallel Port FIFO (Mode 101)

The standard parallel port is run at or near the peak 500KBytes/sec allowed in the forward direction using DMA. The state machine does not examine ACK# and begins the next transfer based on Busy. Refer to [FIGURE 22-16: on page 217](#).

### ECP Parallel Port Timing

The timing is designed to allow operation at approximately 2.0 Mbytes/sec over a 15ft cable. If a shorter cable is used then the bandwidth will increase.

#### Forward-Idle

When the host has no data to send it keeps HostClk (STROBE#) high and the peripheral will leave PeriphClk (Busy) low.

#### Forward Data Transfer Phase

The interface transfers data and commands from the host to the peripheral using an interlocked PeriphAck and HostClk. The peripheral may indicate its desire to send data to the host by asserting nPeriphRequest.

The Forward Data Transfer Phase may be entered from the Forward-Idle Phase. While in the Forward Phase the peripheral may asynchronously assert the nPeriphRequest (nFault) to request that the channel be reversed. When the peripheral is not busy it sets PeriphAck (Busy) low. The host then sets HostClk (STROBE#) low when it is prepared to send data. The data must be stable for the specified setup time prior to the falling edge of HostClk. The peripheral then sets PeriphAck (Busy) high to acknowledge the handshake. The host then sets HostClk (STROBE#) high. The peripheral then accepts the data and sets PeriphAck (Busy) low, completing the transfer. This sequence is shown in [FIGURE 22-17: on page 217](#).

The timing is designed to provide 3 cable round-trip times for data setup if Data is driven simultaneously with HostClk (STROBE#).

#### Reverse-Idle Phase

The peripheral has no data to send and keeps PeriphClk high. The host is idle and keeps HostAck low.

#### Reverse Data Transfer Phase

The interface transfers data and commands from the peripheral to the host using an interlocked HostAck and PeriphClk.

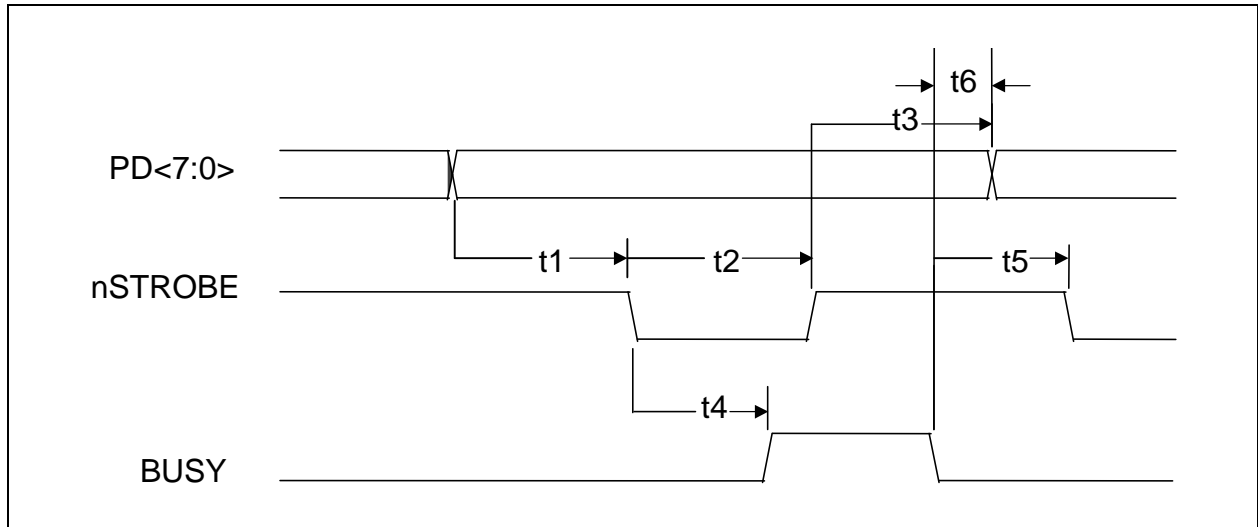
The Reverse Data Transfer Phase may be entered from the Reverse-Idle Phase. After the previous byte has been accepted the host sets HostAck (ALF#) low. The peripheral then sets PeriphClk (ACK#) low when it has data to send. The data must be stable for the specified setup time prior to the falling edge of PeriphClk. When the host is ready to accept a byte it sets HostAck (ALF#) high to acknowledge the handshake. The peripheral then sets PeriphClk (ACK#) high. After the host has accepted the data, it sets HostAck (ALF#) low, completing the transfer. This sequence is shown in [FIGURE 22-18: on page 218](#).

### Output Drivers

To facilitate higher performance data transfer, the use of balanced CMOS active drivers for critical signals (Data, HostAck, HostClk, PeriphAck, PeriphClk) are used in ECP Mode. Because the use of active drivers can present compatibility problems in Compatible Mode (the control signals, by tradition, are specified as open-drain), the drivers are dynamically changed from open-drain to push-pull. The timing for the dynamic driver change is specified in the *IEEE 1284 Extended Capabilities Port Protocol and ISA Interface Standard, Rev. 1.14*, July 14, 1993, available from Microsoft. The dynamic driver change must be implemented properly to prevent glitching the outputs.



**FIGURE 22-16: PARALLEL PORT FIFO TIMING**

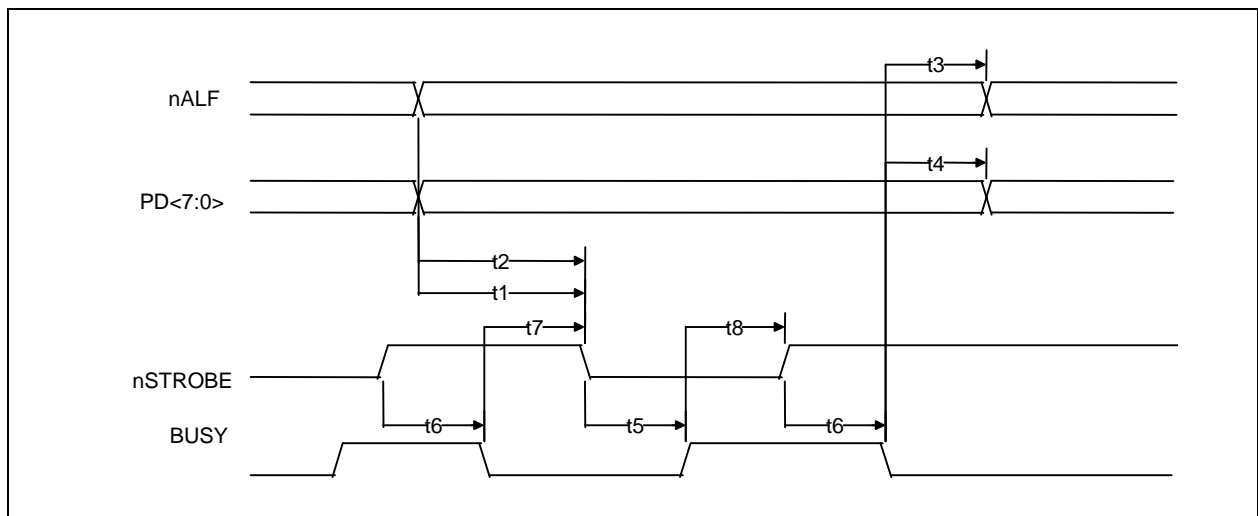


**TABLE 22-11: PARALLEL PORT FIFO TIMING PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	PDATA Valid to STROBE# Active	600			ns
t2	STROBE# Active Pulse Width	600			ns
t3	PDATA Hold from STROBE# Inactive (See Note 22-1)	450			ns
t4	STROBE# Active to BUSY Active			500	ns
t5	BUSY Inactive to STROBE# Active	680			ns
t6	BUSY Inactive to PDATA Invalid (See Note 22-1)	80			ns

**Note 22-1** The data is held until BUSY goes inactive or for time t3, whichever is longer. This only applies if another data transfer is pending. If no other data transfer is pending, the data is held indefinitely.

**FIGURE 22-17: ECP PARALLEL PORT FORWARD TIMING**



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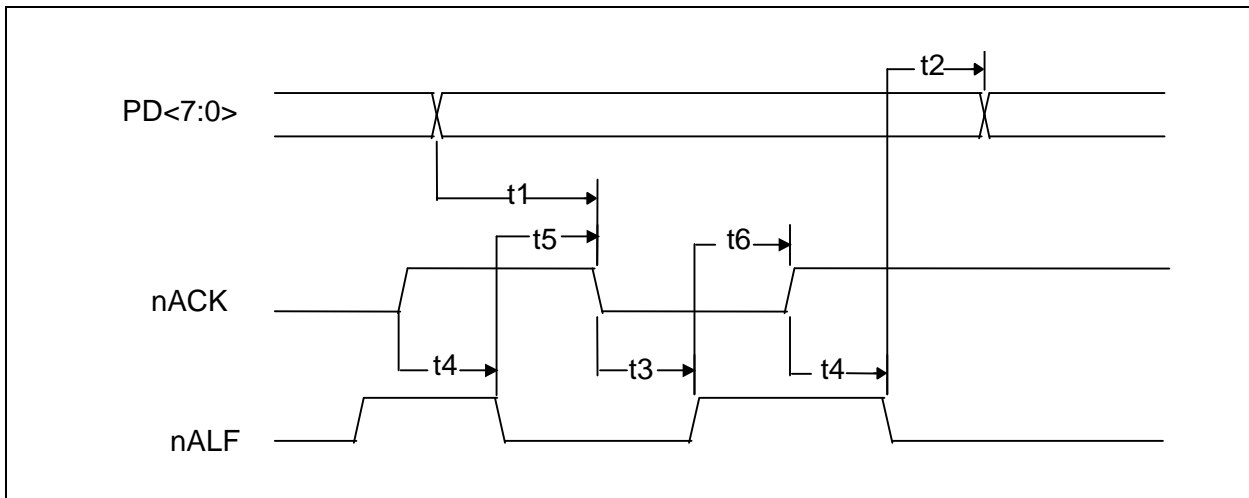
**TABLE 22-12: ECP PARALLEL PORT FORWARD TIMING PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	ALF# Valid to STROBE# Asserted	0		60	ns
t2	PDATA Valid to STROBE# Asserted	0		60	ns
t3	BUSY Deasserted to ALF# Changed (Note 22-2, Note 22-3)	80		180	ns
t4	BUSY Deasserted to PDATA Changed (Note 22-2, Note 22-3)	80		180	ns
t5	STROBE# Asserted to Busy Asserted	0			ns
t6	STROBE# Deasserted to Busy Deasserted	0			ns
t7	BUSY Deasserted to STROBE# Asserted (Note 22-2, Note 22-3)	80		200	ns
t8	BUSY Asserted to STROBE# Deasserted (Note 22-3)	80		180	ns

**Note 22-2** Maximum value only applies if there is data in the FIFO waiting to be written out.

**Note 22-3** BUSY is not considered asserted or deasserted until it is stable for a minimum of 75 to 130 ns.

**FIGURE 22-18: ECP PARALLEL PORT REVERSE TIMING**



**TABLE 22-13: ECP PARALLEL PORT REVERSE TIMING PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	PDATA Valid to ACK# Asserted	0			ns
t2	ALF# Deasserted to PDATA Changed	0			ns
t3	ACK# Asserted to ALF# Deasserted (Note 22-4, Note 22-5)	80		200	ns
t4	ACK# Deasserted to ALF# Asserted (Note 22-5)	80		200	ns
t5	ALF# Asserted to ACK# Asserted	0			ns
t6	ALF# Deasserted to ACK# Deasserted	0			ns

**Note 22-4** Maximum value only applies if there is room in the FIFO and terminal count has not been received. ECP can stall by keeping ALF# low.

**Note 22-5** ACK# is not considered asserted or deasserted until it is stable for a minimum of 75 to 130 ns.

## 22.6 Serial Port (UART) Data Timing

FIGURE 22-19: SERIAL PORT DATA

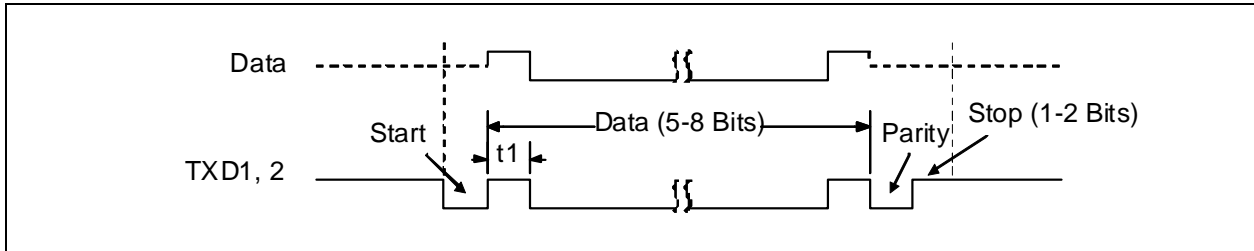


TABLE 22-14: SERIAL PORT DATA PARAMETERS

Name	Description	MIN	TYP	MAX	Units
t1	Serial Port Data Bit Time		t <sub>BR</sub> (Note 2-6)		nsec

**Note 22-6** t<sub>BR</sub> is 1/Baud Rate. The Baud Rate is programmed through the divisor latch registers. Baud Rates have percentage errors indicated in [Table 9-20, "UART Baud Rates \(1.8432MHz source\),"](#) on page 79.

## 22.7 Keyboard/Mouse Port Timings

FIGURE 22-20: KEYBOARD/MOUSE RECEIVE/SEND DATA TIMING

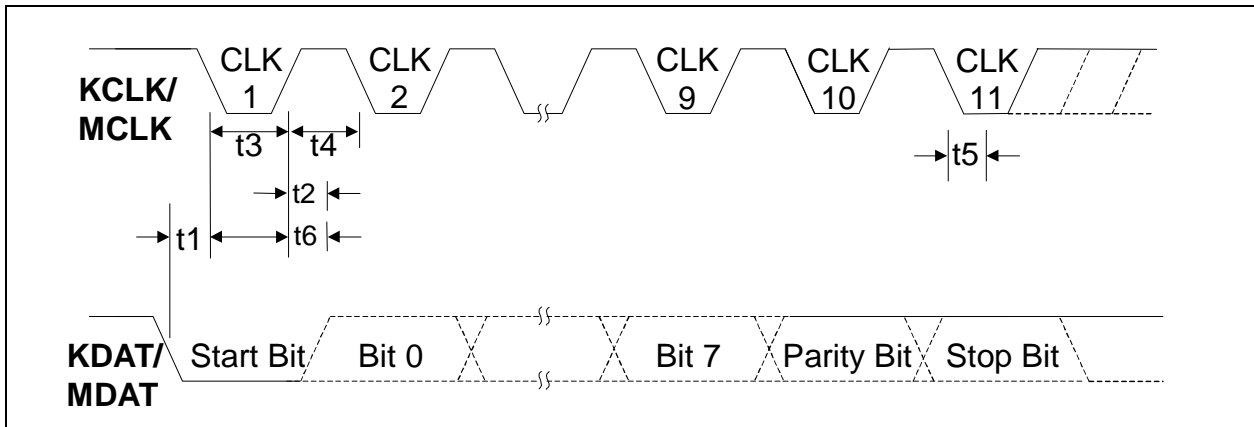


TABLE 22-15: KEYBOARD/MOUSE RECEIVE/SEND DATA TIMING PARAMETERS

Name	Description	MIN	TYP	MAX	Units
t1	Time from DATA transition to falling edge of CLOCK (Receive)	5		25	μsec
t2	Time from rising edge of CLOCK to DATA transition (Receive)	5		T4-5	μsec
t3	Duration of CLOCK inactive (Receive/Send)	30		50	μsec
t4	Duration of CLOCK active (Receive/Send)	30		50	μsec
t5	Time to keyboard inhibit after clock 11 to ensure the keyboard does not start another transmission (Receive)	>0		50	μsec
t6	Time from inactive to active CLOCK transition, used to time when the auxiliary device samples DATA (Send)	5		25	μsec

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## 22.8 I<sup>2</sup>C/SMBus Timing

FIGURE 22-21: I<sup>2</sup>C/SMBUS TIMING

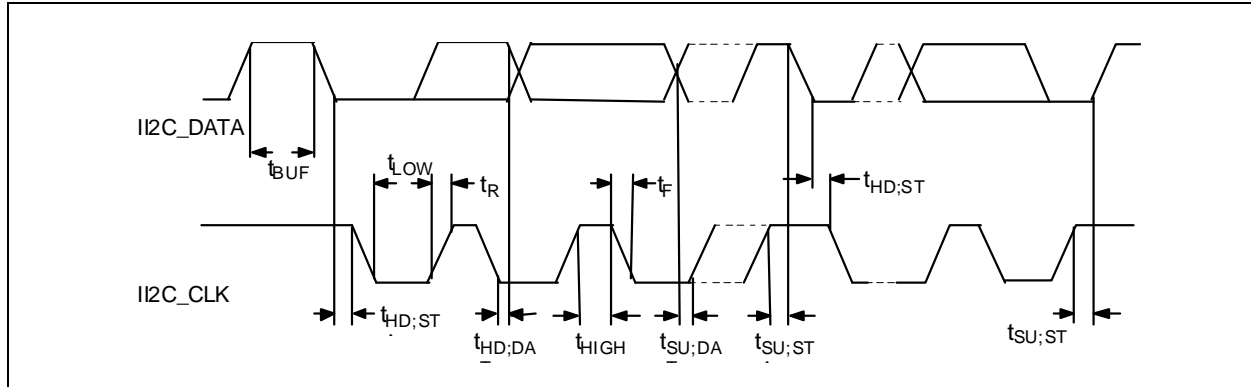
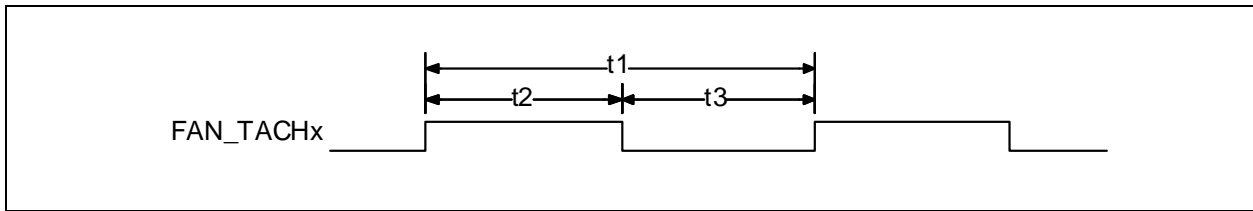


TABLE 22-16: I<sup>2</sup>C/SMBUS TIMING PARAMETERS

Symbol	Parameter	Standard-Mode		Fast-Mode		Unit
		MIN.	MAX.	MIN.	MAX.	
$f_{SCL}$	SCL Clock Frequency		100		400	kHz
$t_{BUF}$	Bus Free Time	4.7		1.3		$\mu$ s
$t_{SU;STA}$	START Condition Set-Up Time	4.7		0.6		$\mu$ s
$t_{HD;STA}$	START Condition Hold Time	4.0		0.6		$\mu$ s
$t_{LOW}$	SCL LOW Time	4.7		1.3		$\mu$ s
$t_{HIGH}$	SCL HIGH Time	4.0		0.6		$\mu$ s
$t_{R}$	SCL and SDA Rise Time		1.0		0.3	$\mu$ s
$t_{F}$	SCL and SDA Fall Time		0.3		0.3	$\mu$ s
$t_{SU;DAT}$	Data Set-Up Time	0.25		0.1		$\mu$ s
$t_{HD;DAT}$	Data Hold Time	0		0		$\mu$ s
$t_{SU;STO}$	STOP Condition Set-Up Time	4.0		0.6		$\mu$ s

## 22.9 Fan Tachometer Timing

**FIGURE 22-22: FAN TACHOMETER INPUT TIMING**



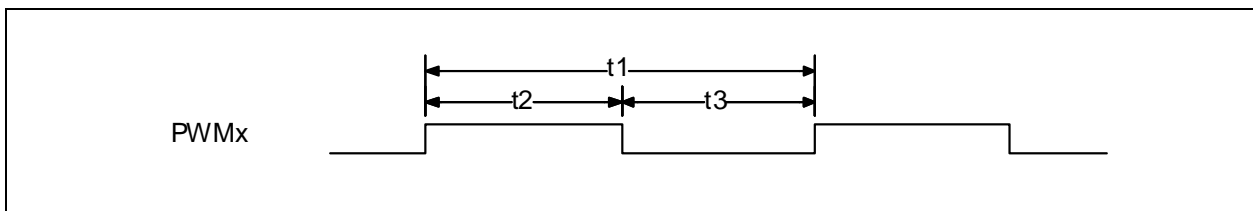
**TABLE 22-17: FAN TACHOMETER INPUT TIMING PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	Pulse Time	100			μsec
t2	Pulse High Time				
t3	Pulse Low Time	10			

**Note 22-7**  $t_{TACH}$  is the clock used for the tachometer counter. It is 30.52 \* prescaler, where the prescaler is programmed in the Fan Tachometer Timebase Prescaler register.

## 22.10 PWM Timing

**FIGURE 22-23: PWM OUTPUT TIMING**



**TABLE 22-18: PWM TIMING PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
t1	Period	31ns		23.3sec	
$t_f$	Frequency	0.04Hz		32MHz	
t2	High Time	0		11.65	sec
t3	Low Time	0		11.65	sec
$t_d$	Duty cycle	0		100	%

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## 22.11 Yellow and Green LED Interface

FIGURE 22-24: YELLOW/GREEN OUTPUT TIMING

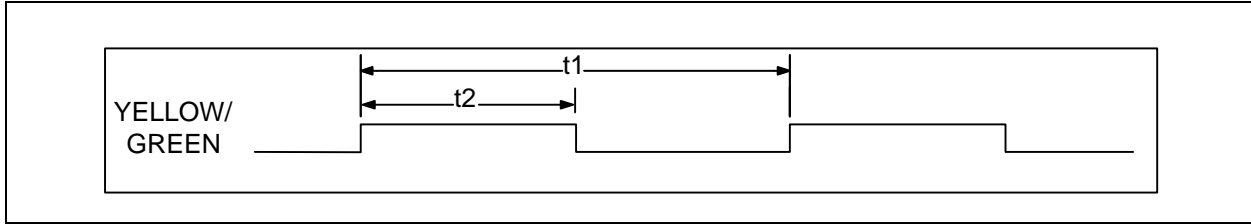


TABLE 22-19: YELLOW/GREEN OUTPUT TIMING PARAMETERS

Name	Description	MIN	TYP	MAX	Units
$t_1$	Period		1	3.03 (Note 22-8)	sec
$t_2$	Blink ON Time	0	0.5	1.52 (Note 22-8)	sec

**Note 22-8** The blink rate is programmed through Bits[1:0] in LEDx register. When Bits[1:0]=00, LED is OFF. Bits[1:0]=01 indicates LED blink at 1Hz rate with a 50% duty cycle (0.5 sec ON, 0.5 sec OFF). When Bits[1:0]=11, LED is ON.

## 22.12 GPIO Timings

FIGURE 22-25: GPIO TIMING

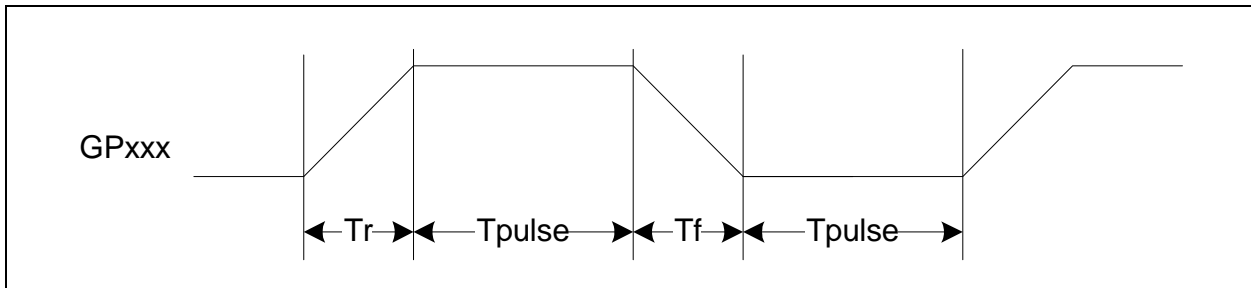


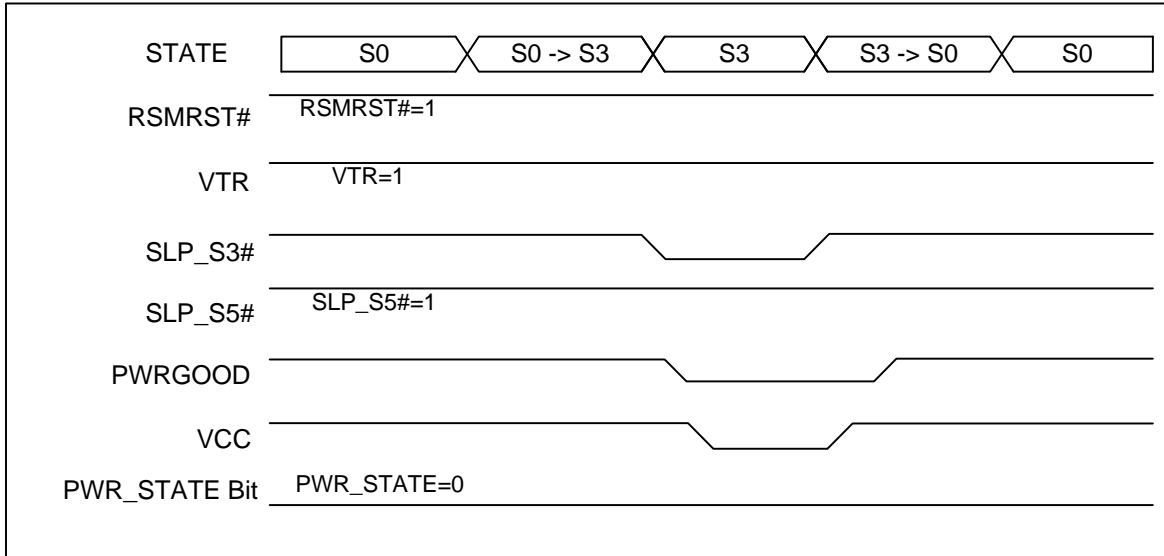
TABLE 22-20: GPIO TIMING PARAMETERS

Symbol	Parameter	MIN	TYP	MAX	Unit	Notes
$t_R$	GPIO Rise Time (push-pull)	1.3		2.6	ns	Pad type = IO4/IO8, $C_L=10pF$
$t_F$	GPIO Fall Time	1.2		2.6	ns	
$t_R$	GPIO Rise Time (push-pull)	0.9		1.8	ns	Pad type = IO12/IO16, $C_L=10pF$
$t_F$	GPIO Fall Time	0.9		2.0	ns	
$t_{pulse}$	GPIO Pulse Width	60			ns	

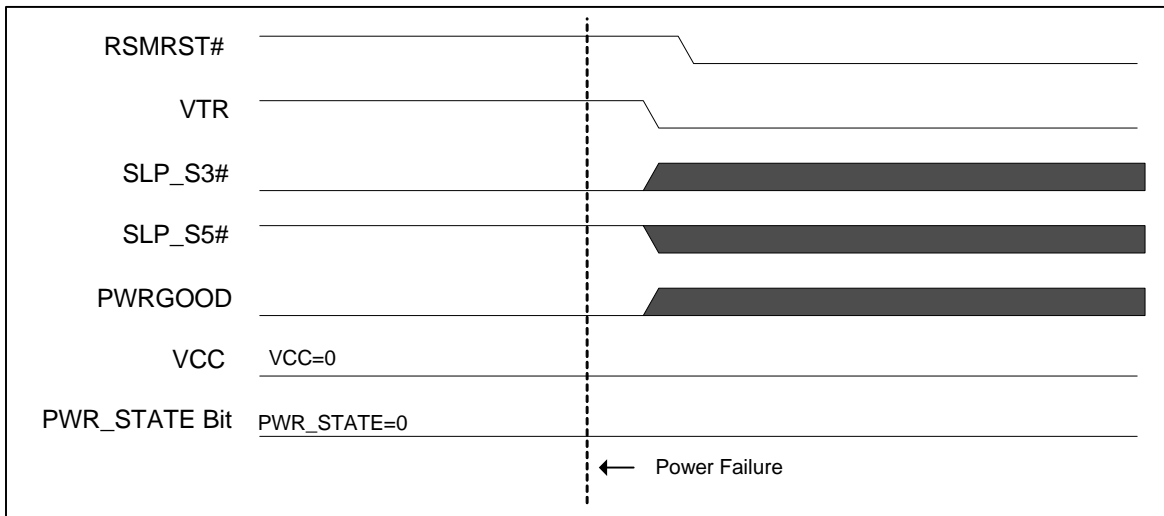
## 22.13 PWR\_STATE Timings

The following representative timing is included to illustrate the relation of the PWR\_STATE bit.

**FIGURE 22-26: NORMAL POWER SUPPLY SEQUENCE (S0-S3-S0)**

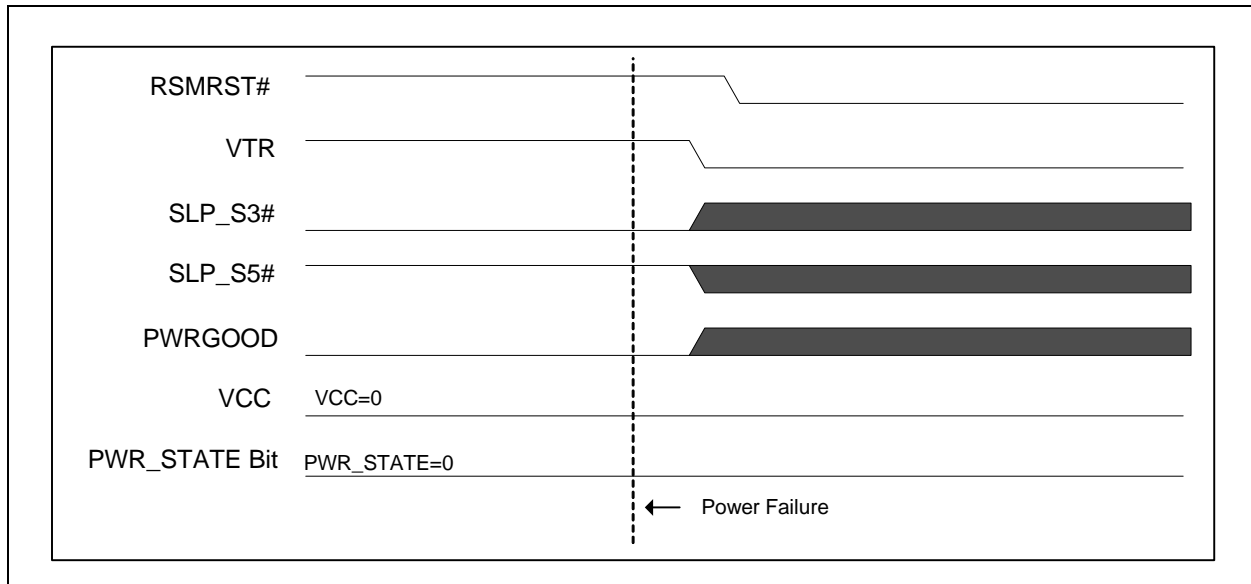


**FIGURE 22-27: S0 POWER FAILURE**

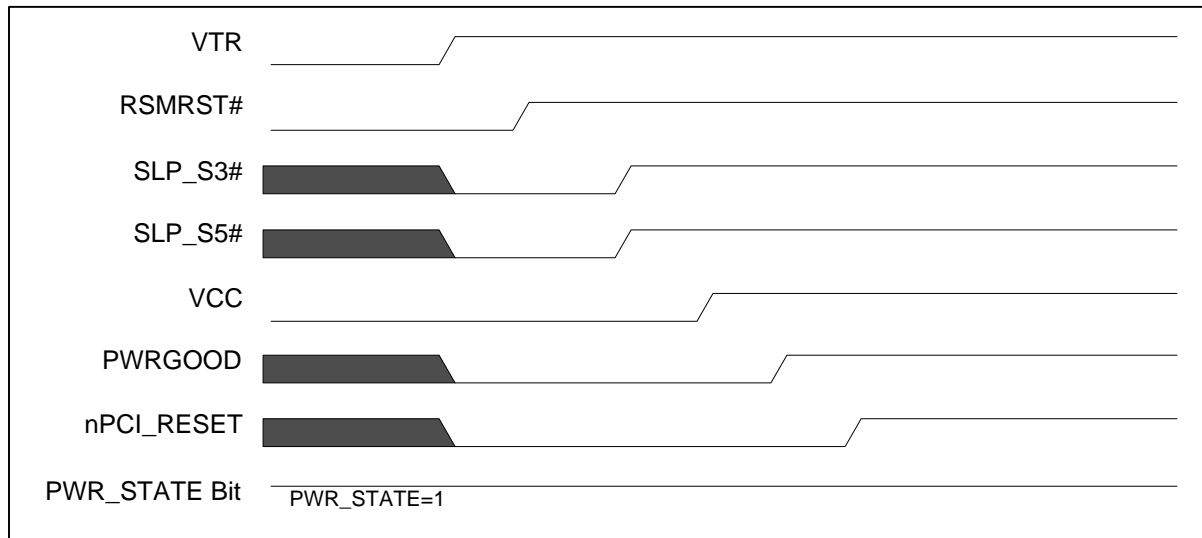


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**FIGURE 22-28: S3 POWER FAILURE**

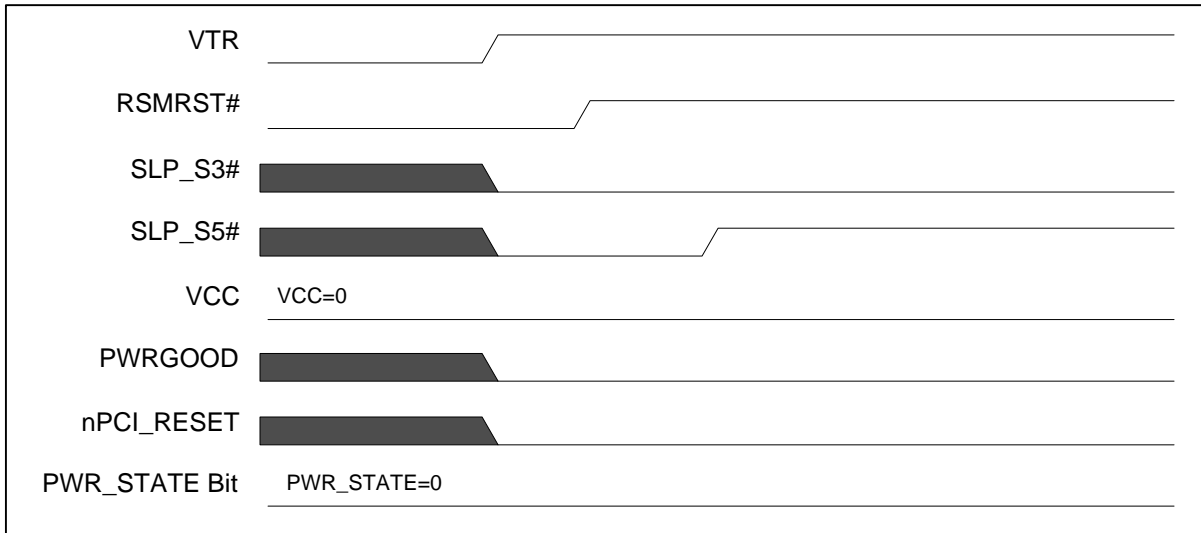


**FIGURE 22-29: G3 (POWER FAILURE) TO S0**



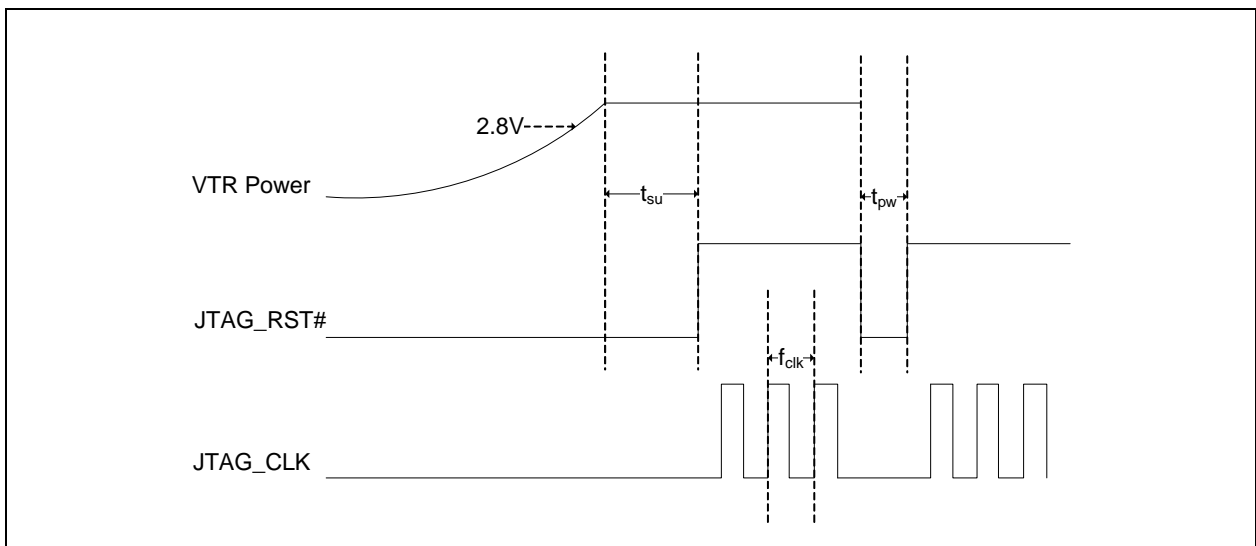


**FIGURE 22-30: G3 (POWER FAILURE) TO S3**



## 22.14 JTAG Interface Timing

**FIGURE 22-31: JTAG POWER-UP & ASYNCHRONOUS RESET TIMING**



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FIGURE 22-32: JTAG SETUP & HOLD PARAMETERS

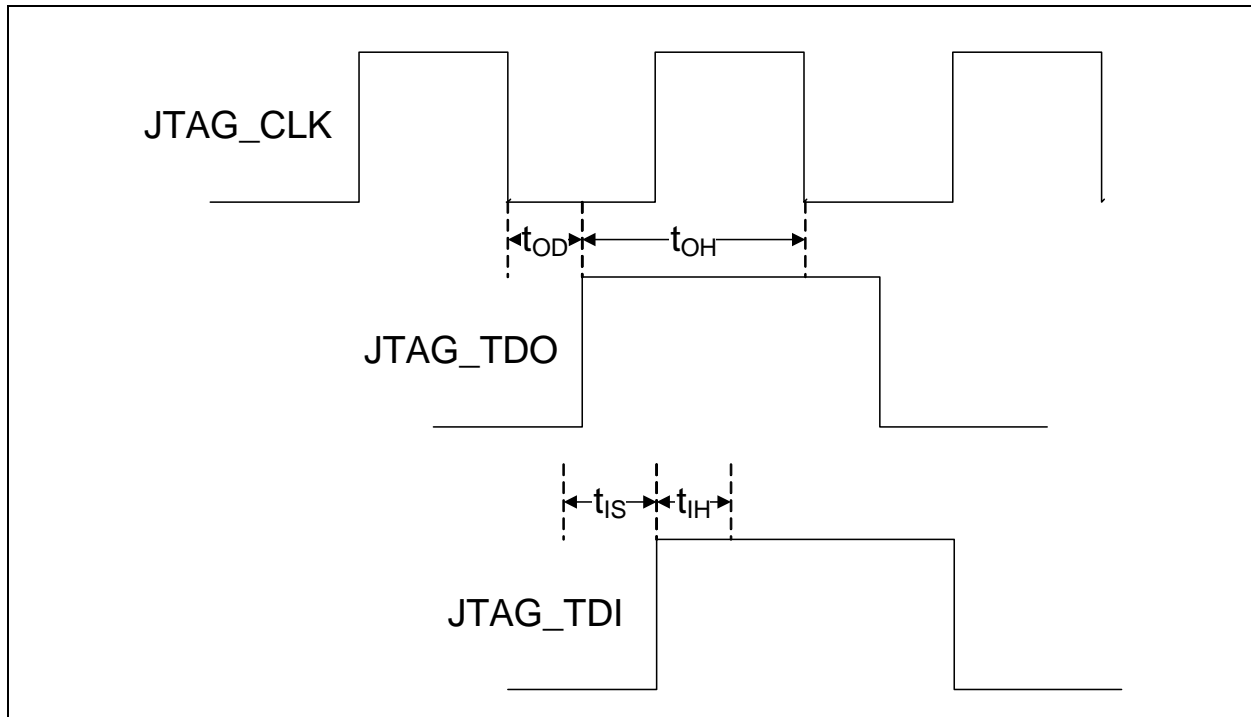


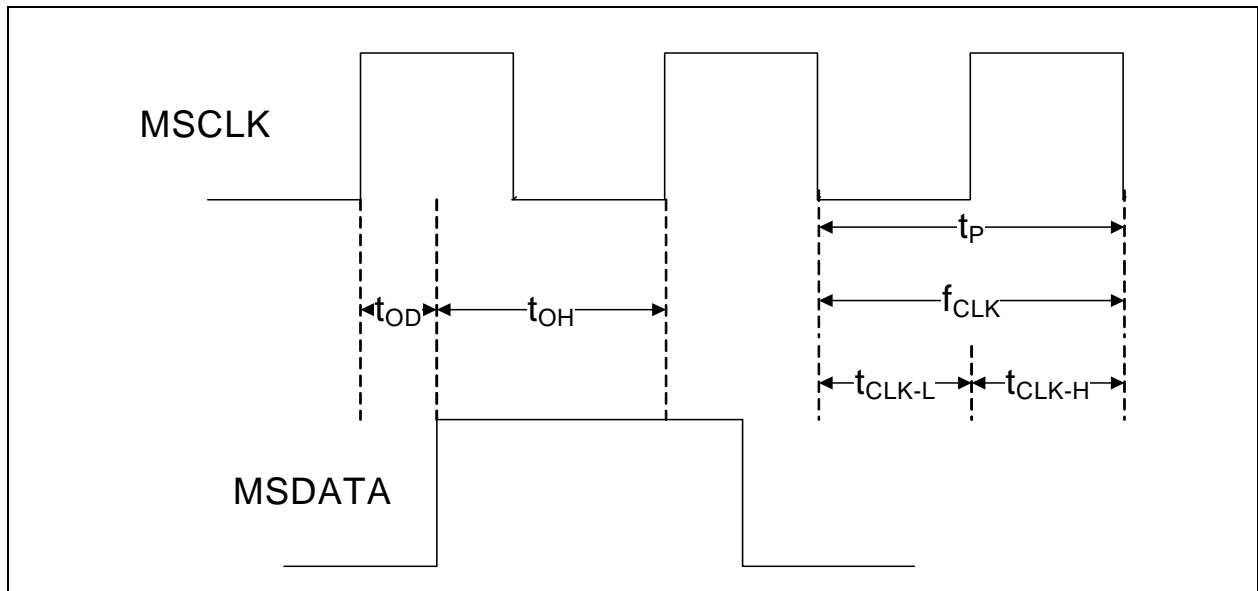
TABLE 22-21: JTAG INTERFACE TIMING PARAMETERS

Name	Description	MIN	TYP	MAX	Units
$t_{su}$	JTAG_RST# de-assertion after VTR power is applied	500			$\mu$ s
$t_{pw}$	JTAG_RST# assertion pulse width	500			nsec
$f_{clk}$	JTAG_CLK frequency (see note)			8	MHz
$t_{OD}$	TDO output delay after falling edge of TCLK.	5		10	nsec
$t_{OH}$	TDO hold time after falling edge of TCLK	$1 \text{ TCLK} - t_{OD}$			nsec
$t_{IS}$	TDI setup time before rising edge of TCLK.	5			nsec
$t_{IH}$	TDI hold time after rising edge of TCLK.	5			nsec

**Note:**  $f_{clk}$  is the maximum frequency to access a JTAG Register. Additional JTAG\_CLK frequency constraints are described in [Section 20.3.2, "Clocks,"](#) on page 191.

## 22.15 Serial Debug Port Timing

**FIGURE 22-33: SERIAL DEBUG PORT TIMING PARAMETERS**



**TABLE 22-22: SERIAL DEBUG PORT INTERFACE TIMING PARAMETERS**

Name	Description	MIN	TYP	MAX	Units
$f_{clk}$	MSCLK frequency (see note)	8	-	32	MHz
$t_{OD}$	MSDATA output delay after falling edge of MSCLK.			5	nsec
$t_{OH}$	MSDATA hold time after falling edge of MSCLK	1 MSCLK - $t_{OD}$			nsec
$t_P$	MSCLK Period.	1/ $f_{clk}$			$\mu$ s
$t_{CLK-L}$	MSCLK Low Time	$t_P/2 - 3$		$t_P/2 + 3$	nsec
$t_{CLK-H}$	MSCLK high Time (see <a href="#">Note 22-9</a> )	$t_P/2 - 3$		$t_P/2 + 3$	nsec

**Note 22-9** When the [EC\\_CLK\\_DIV](#) is an odd number value greater than 2h, then  $t_{CLK-L} = t_{CLK-H} + 15$ ns. When the [EC\\_CLK\\_DIV](#) is 0h, 1h, or an even number value greater than 2h, then  $t_{CLK-L} = t_{CLK-H}$ .

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## 22.16 Input Clock Timing

FIGURE 22-34: INPUT CLOCK TIMING

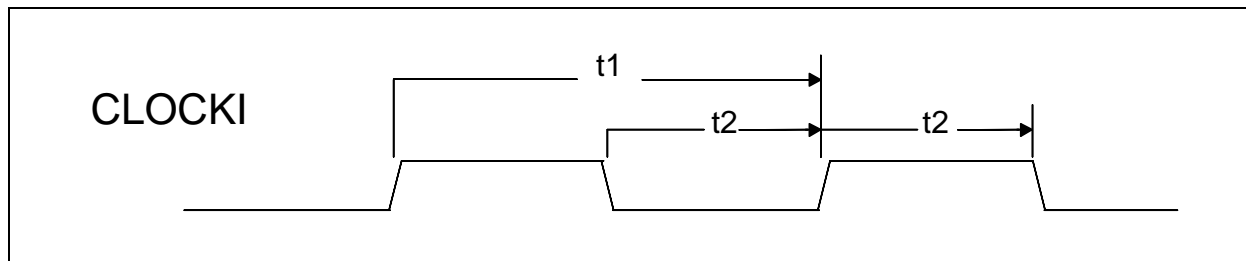
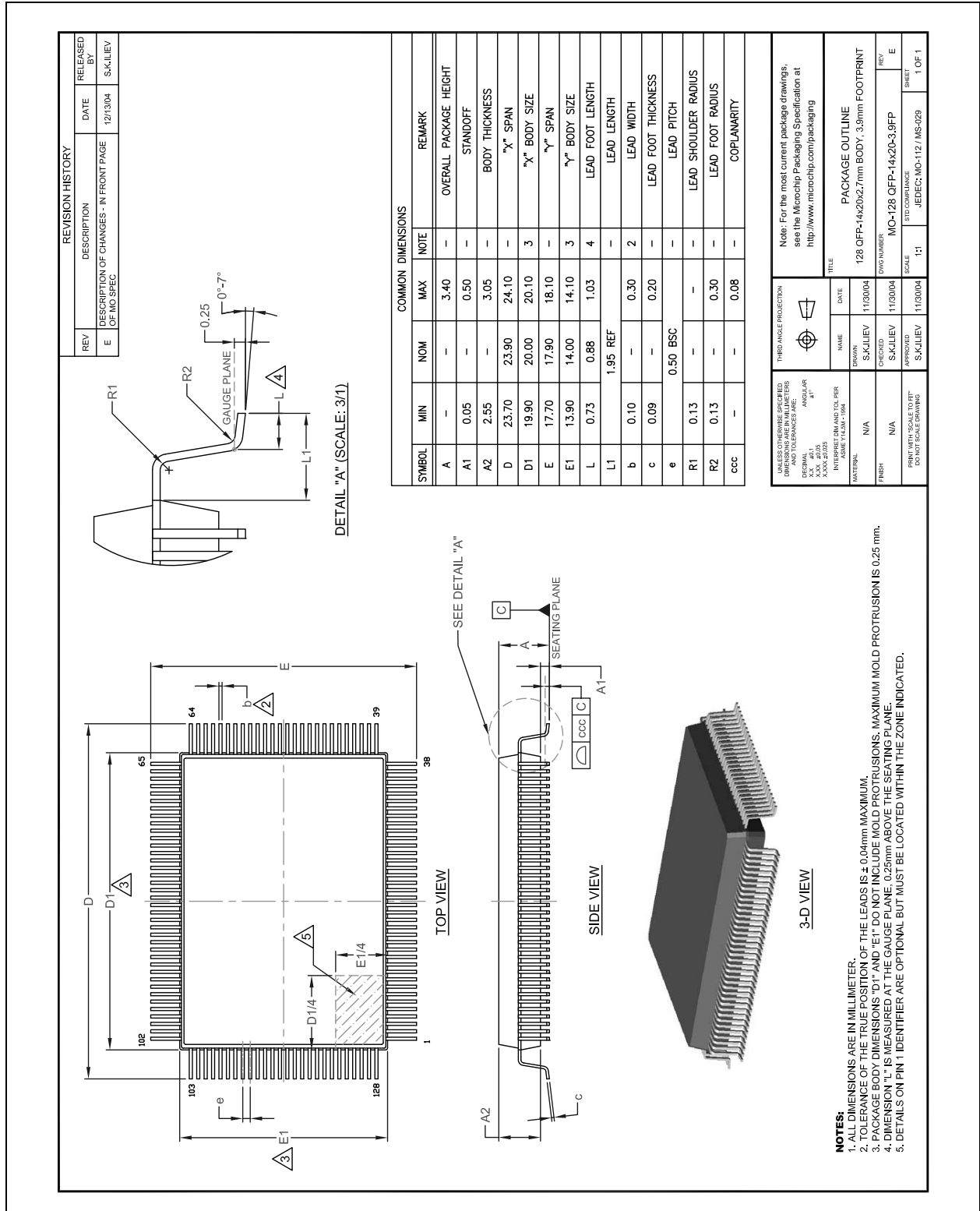


TABLE 22-23: INPUT CLOCK TIMING PARAMETERS

Name	Description	MIN	TYP	MAX	Units
t1	Clock Cycle Time for 14.318MHZ		69.84		ns
t2	Clock High Time/Low Time for 14.318MHz	20	35		ns
	Clock Rise Time/Fall Time (not shown)			5	ns

## 23.0 PACKAGE OUTLINE

FIGURE 23-1: 128-PIN QFP PACKAGE OUTLINE (3.9MM FOOTPRINT)



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## APPENDIX A: DATA SHEET REVISION HISTORY

TABLE A-1: REVISION HISTORY

REVISION LEVEL & DATE	SECTION/FIGURE/ENTRY	CORRECTION
DS-00001996A (09-16-15)		Replaces previous SMSC version Rev. 0.30 (01-25-10).
Rev. 0.30 (01-25-10)	Table 3-1, "Signal Descriptions"	Buffer type for PWRBTN_OUT# changed from "O8" to "OD8".
Rev. 0.30 (01-25-10)	Section 5.2.1, "32.768KHz Clock Input"	Text modified from: "Until the 32KHz clock input is available, the internal 32KHz clock is derived from an internal ring oscillator."  to "When the 32KHz clock input is not available, the internal 32KHz clock is derived from an internal ring oscillator."
		Removed the following note: "Once started, the CLK32 clock input must remain active until VTR is removed."
Rev. 0.30 (01-12-10)	Table 3-1, "Signal Descriptions"	Removed relation between PWRGD_PS and 14M/PCI clocks. Added PCICLK requirement to LRESET#
	Table 21-2, "DC Electrical Characteristics",	Added AMD voltage specification
	Table 16-25, "Power Good Register",	Fixed order of PCIRST_OUT enable bits
	Table 21-3, "SCH5627P Power Consumption"	Fixed power consumption numbers
Rev. 0.28 (08-14-09)		Initial data sheet creation

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<p><b>PART NO.</b> <sup>(1)</sup> - <b>XXX</b> <sup>(2)</sup></p> <p>Device                      Package</p>	<p><b>Example:</b></p> <p>SCH5627P-NS = 128-pin QFP</p>
<p>Device:            SCH5627P <sup>(1)</sup></p> <p>Package:        NS    =    128-pin QFP <sup>(2)</sup></p>	<p><b>Note 1:</b>    These products meet the halogen maximum concentration values per IEC61249-2-21.</p> <p><b>Note 2:</b>    All package options are RoHS compliant. For RoHS compliance and environmental information, please visit <a href="http://www.microchip.com/pagehandler/en-us/aboutus/ehs.html">http://www.microchip.com/pagehandler/en-us/aboutus/ehs.html</a> .</p>



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