



**THE DATASHEET OF  
NS9750B-A1-C200**



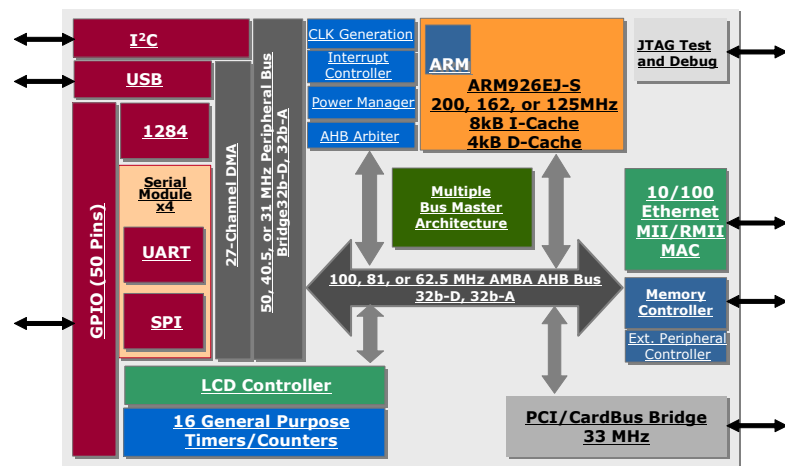


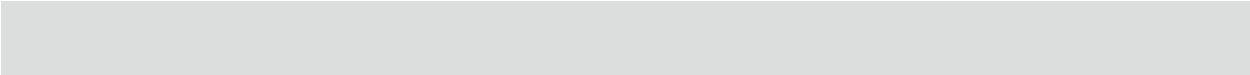
## NS9750B-A1 Datasheet

The Digi NS9750B-A1 is a single chip 0.13 $\mu$ m CMOS network-attached processor. The CPU is the ARM926EJ-S core with MMU, DSP extensions, Jazelle Java accelerator, and 8 kB of instruction cache and 4 kB of data cache in a Harvard architecture. The NS9750B-A1 runs up to 200 MHz, with a 100 MHz system and memory bus and 50 MHz peripheral bus. The NS9750B-A1 operates at a 1.5V core and 3.3V I/O ring voltages.

With its extensive set of I/O interfaces, Ethernet high-speed performance and processing capacity, the NS9750B-A1 is the most capable of highly integrated 32-bit network-attached processors available. The NS9750B-A1 is designed specifically for use in high-performance intelligent networked devices and Internet appliances including high-performance/low-latency remote I/O, intelligent networked information displays, and streaming and surveillance cameras. The NS9750B-A1 is a member of the award-winning NET+ARM family of system-on-chip (SOC) solutions for embedded systems.

The NS9750B-A1 offers a connection to an external bus expansion module as well as a glueless connection to SDRAM, PC100 DIMM, Flash, EEPROM, and SRAM memories. It includes a versatile embedded LCD controller that supports up to 16M color TFT or 3375 color STN. The NS9750B-A1





features a PCI/CardBus port as well as a USB port for applications that require WLAN, external storage, or external sensors, imagers, or scanners. Four multi-function serial ports, an I<sup>2</sup>C port, and 1284 parallel port provide a standard glueless interface to a variety of external peripherals. The NS9750B-A1 also features up to 50 general purpose I/O (GPIO) pins and highly-configurable power management with sleep mode.

NET+ARM processors are the foundation for the NET+Works® family of integrated hardware and software solutions for device networking. These comprehensive platforms include drivers, operating systems, networking software, development tools, APIs, and complete development boards.


Using the NS9750B-A1 and associated Net+Works packages allows system designers to achieve dramatic time-to-market reductions with pre-integrated and tested NET+ARM hardware, NET+Works software, and tools. Product unit costs are reduced dramatically with a complete system-on-chip, including Ethernet, display support, a robust peripheral set, and the processing headroom to meet the most demanding applications. Customers save engineering resources, as no network development is required. Companies will reduce their design risk with a fully integrated and tested solution.

A complete NET+Works development package includes ThreadX™ picokernel RTOS, Green Hills™ MULTI® 2000 IDE or Microcross GNU X-Tools™, drivers, networking protocols and services with APIs, NET+ARM-based development board, Digi-supplied utilities, integrated file system, JTAG In Circuit Emulator (ICE), and support for boundary scan description language (BSDL). One year software maintenance and technical support is available.

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## NS9750B-A1 Features

### 32-bit ARM926EJ-S RISC processor

- 125 to 200 MHz
- 5-stage pipeline with interlocking
- Harvard architecture
- 8 kB instruction cache and 4 kB data cache
- 32-bit ARM and 16-bit Thumb instruction sets. Can be mixed for performance/code density tradeoffs
- MMU to support virtual memory-based OSs such as Linux, WinCE/Pocket PC, VxWorks, others
- DSP instruction extensions, improved divide, single cycle MAC
- ARM Jazelle, 1200CM (coffee marks) Java accelerator
- EmbeddedICE-RT debug unit
- JTAG boundary scan, BSDL support

### External system bus interface

- 32-bit data, 32-bit internal address bus, 28-bit external address bus
- Glueless interface to SDRAM, SRAM, EEPROM, buffered DIMM, Flash
- 4 static and 4 dynamic memory chip selects
- 1-32 wait states per chip select  
A shared Static Extended Wait register allows transfers to have up to 16368 wait states that can be externally terminated.
- Self-refresh during system sleep mode
- Automatic dynamic bus sizing to 8 bits, 16 bits, 32 bits
- Burst mode support with automatic data width adjustment

- Two external DMA channels for external peripheral support

### System Boot

- High-speed boot from 8-bit, 16-bit, or 32-bit ROM or Flash
- Hardware-supported low cost boot from serial EEPROM through SPI port (patent pending)

### High performance 10/100 Ethernet MAC

- 10/100 Mbps MII/RMII PHY interfaces
- Full-duplex or half-duplex
- Station, broadcast, or multicast address filtering
- 2 kB RX FIFO
- 256 byte TX FIFO with on-chip buffer descriptor ring
  - Eliminates underruns and decreases bus traffic
- Separate TX and RX DMA channels
- Intelligent receive-side buffer size selection
- Full statistics gathering support
- External CAM filtering support

### PCI/CardBus port

- PCI v2.2, 32-bit bus, up to 33 MHz bus speed
- Programmable to:
  - PCI device mode
  - PCI host mode:
    - Supports up to 3 external PCI devices
    - Embedded PCI arbiter or external arbiter
- CardBus host mode

**Flexible LCD controller**

- Supports most commercially available displays:
  - Active Matrix color TFT displays – Up to 24bpp direct 8:8:8 RGB; 16M colors
  - Single and dual panel color STN displays – Up to 16bpp 4:4:4 RGB; 3375 colors
  - Single and dual-panel monochrome STN displays – 1, 2, 4bpp palettized gray scale
- Formats image data and generates timing control signals
- Internal programmable palette LUT and grayscale support different color techniques
- Programmable panel-clock frequency

**USB ports**

- USB v.2.0 full speed (12 Mbps) and low speed (1.5 Mbps)
- Configurable to device or OHCI host
  - USB host is bus master
  - USB device supports one bidirectional control endpoint and 11 unidirectional endpoints
- All endpoints supported by a dedicated DMA channel; 13 channels total
- 20 byte RX FIFO and 20 byte TX FIFO

**Serial ports**

- 4 serial modules, each independently configurable to UART mode, SPI master mode, or SPI slave mode
- Bit rates from 75 bps to 921.6 kbps: asynchronous x16 mode
- Bit rates from 1.2 kbps to 6.25 Mbps: synchronous mode
- UART provides:

- High-performance hardware and software flow control
- Odd, even, or no parity
- 5, 6, 7, or 8 bits
- 1 or 2 stop bits
- Receive-side character and buffer gap timers

- Internal or external clock support, digital PLL for RX clock extraction
- 4 receive-side data match detectors
- 2 dedicated DMA channels per module, 8 channels total
- 32 byte TX FIFO and 32 byte RX FIFO per module

**I<sup>2</sup>C port**

- I<sup>2</sup>C v.1.0, configurable to master or slave mode
- Bit rates: fast (400 kHz) or normal (100 kHz) with clock stretching
- 7-bit and 10-bit address modes
- Supports I<sup>2</sup>C bus arbitration

**1284 parallel peripheral port**

- All standard modes: ECP, byte, nibble, compatibility (also known as SPP or “Centronix”)
- RLE (run length encoding) decoding of compressed data in ECP mode
- Operating clock from 100 kHz to 2 MHz
- Two dedicated DMA channels

**High performance multiple-master/distributed DMA system**

- Intelligent bus bandwidth allocation (patent pending)
- System bus and peripheral bus

**System bus:**

- Every system bus peripheral is a bus master with a dedicated DMA engine

**Peripheral bus:**

- One 13-channel DMA engine supports USB device
  - 2 DMA channels support control endpoint
  - 11 DMA channels support 11 endpoints
- One 12-channel DMA engine supports:
  - 4 serial modules (8 DMA channels)
  - 1284 parallel port (4 DMA channels)
- All DMA channels support fly-by mode

**External peripheral:**

- One 2-channel DMA engine supports external peripheral connected to memory bus
- Each DMA channel supports memory-to-memory transfers

**Power management (patent pending)**

- Power save during normal operation
  - Disables unused modules
- Power save during sleep mode
  - Sets memory controller to refresh
  - Disables all modules except selected wakeup modules
  - Wakeup on valid packets or characters

**Vector interrupt controller**

- Decreased bus traffic and rapid interrupt service
- Hardware interrupt prioritization

**General purpose timers/counters**

- 16 independent 16-bit or 32-bit programmable timers or counters
  - Each with an I/O pin
- Mode selectable into:
  - Internal timer mode

- External gated timer mode
- External event counter

- Can be concatenated
- Resolution to measure minute-range events
- Source clock selectable: internal clock or external pulse event
- Each can be individually enabled/disabled

**System timers**

- Watchdog timer
- System bus monitor timer
- System bus arbiter timer
- Peripheral bus monitor timer

**General purpose I/O**

- 50 programmable GPIO pins (muxed with other functions)
- Software-readable powerup status registers for every pin for customer-defined bootstrapping

**External interrupts**

- 4 external programmable interrupts
  - Rising or falling edge-sensitive
  - Low level- or high level-sensitive

**Clock generator**

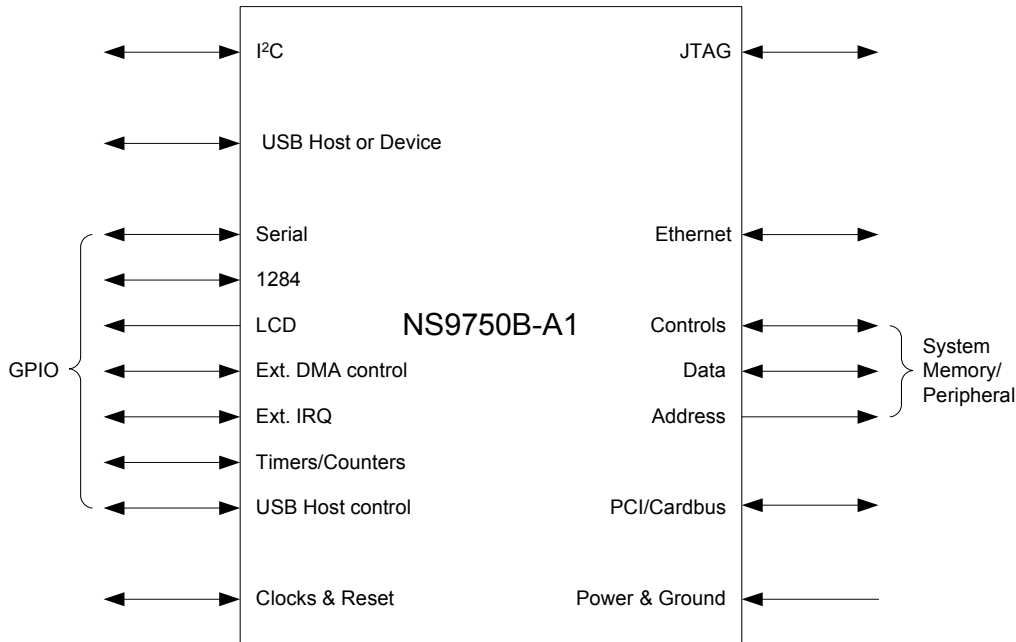
- On-chip phase locked loop (PLL)
- Software programmable PLL parameters
- Optional external oscillator
- Separate PLL for USB

**Operating grades/Ambient temperatures**

- 200 MHz: 0 - 70° C
- 162 MHz: -40 - +85° C
- 125 MHz: 0 - 70° C

## System-level interfaces

Figure 1 shows the NS9750B-A1 system-level hardware interfaces.



**Figure 1: System-level hardware interfaces**

### NS9750B-A1 interfaces

- Ethernet MII/RMII interface to an external PHY
- System Memory interface
  - Glueless connection to SDRAM
  - Glueless connection to buffered PC100 DIMM
  - Glueless connection to SRAM
  - Glueless connection to Flash memory or ROM
- PCI muxed with CardBus interface
- USB host or device interface
- I<sup>2</sup>C interface
- 50 GPIO pins muxed with:
  - Four 8-pin-each serial ports, each programmable to UART or SPI
  - 1284 port
- Up to 24-bit TFT or STN color and monochrome LCD controller
- Two external DMA channels
- Four external interrupt pins programmed to rising or falling edge, or to high or low level
- Sixteen 16-bit or 32-bit programmable timers or counters
- Two control signals to support USB host
- JTAG development interface
- Clock interfaces for crystal or external oscillator
  - System clock
  - USB clock
- Clock interface for optional LCD external oscillator
- Power and ground

## System configuration

The PLL and other system settings can be configured at powerup before the CPU boots. External pins configure the necessary control register bits at powerup. External pulldown resistors can be used to configure the PLL and system configuration registers depending on the application. The recommended value is 2.2k ohm to 2.4k ohm.

This table describes how each bit is used to configure the powerup settings, where 1 indicates the internal pullup resistor and 0 indicates an external pulldown resistor. Table 2 shows PLL ND[4:0] multiplier values. Figure 10, "NS9750B-A1 BGA layout," on page 83 shows the bootstrap pins.

Pin name	Configuration bits
rtck	<b>PCI arbiter configuration</b> 0 External PCI arbiter 1 Internal PCI arbiter
boot_strap[0]	<b>Chip select 1 byte_lane_enable_n/write_enable_n configuration bootstrap select</b> 0 byte_lane_enable_n (2.4K pulldown added) 1 write_enable_n for byte-wide devices (default)
boot_strap[4:3]	<b>Chip select 1 data width bootstrap select</b> 00 16 bits 01 8 bits 11 32 bits
boot_strap[2]	<b>Memory interface read mode bootstrap select</b> <b>Note:</b> An external pulldown resistor must be used; this selects command delayed mode. Clock delayed mode is reserved for future use. 0 Command delayed mode Commands are launched on a 90-degree phase-shifted AHB clock, and AHB clock is routed to the external dynamic memory. 1 Clock delayed mode Reserved for future use.
boot_strap[1]	<b>CardBus mode bootstrap select</b> 0 CardBus mode 1 PCI mode
gpio[49]	<b>Chip select polarity</b> 0 Active high 1 Active low
gpio[44]	<b>Endian mode</b> 0 Big Endian 1 Little Endian
reset_done	<b>Bootup mode</b> 0 Boot from SDRAM using serial SPI EEPROM 1 Boot from flash/ROM

**Table 1: Configuration pins— Bootstrap initialization**

Pin name	Configuration bits															
gpio[19]	RESERVED. This pin must not be pulled to logic 0 until reset_done is a logic 1.															
gpio[17], gpio[12], gpio[10], gpio [8], gpio[4]	<b>PLL ND[4:0] (PLL multiplier, ND+1)</b> See Table 2: PLL ND[4:0].															
gpio[2], gpio[0]	<b>PLL FS[1:0] (PLL frequency select)</b>															
	<table border="1"> <thead> <tr> <th>gpio[2], [0]</th> <th>FS</th> <th>Divide by</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>00</td> <td>1</td> </tr> <tr> <td>11</td> <td>01</td> <td>2</td> </tr> <tr> <td>00</td> <td>10</td> <td>4</td> </tr> <tr> <td>01</td> <td>11</td> <td>8</td> </tr> </tbody> </table>	gpio[2], [0]	FS	Divide by	10	00	1	11	01	2	00	10	4	01	11	8
gpio[2], [0]	FS	Divide by														
10	00	1														
11	01	2														
00	10	4														
01	11	8														

**Table 1: Configuration pins— Bootstrap initialization**

Register configuration: gpio 17, 12, 10, 8, 4	Multiplier
1 1 0 1 0	32
0 0 1 0 0	31
1 1 0 0 0	30
1 1 0 0 1	29
1 1 1 1 0	28
1 1 1 1 1	27
1 1 1 0 0	26
1 1 1 0 1	25
1 0 0 1 0	24
1 0 0 1 1	23
1 0 0 0 0	22
1 0 0 0 1	21
1 0 1 1 0	20
1 0 1 1 1	19
1 0 1 0 0	18
1 0 1 0 1	17
0 1 0 1 0	16
0 1 0 1 1	15
0 1 0 0 0	14
0 1 0 0 1	13
0 1 1 1 0	12

**Table 2: PLL ND[4:0]**

Register configuration: gpio 17, 12, 10, 8, 4	Multiplier
01111	11
01100	10
01101	9
00010	8
00011	7
00000	6
00001	5
00110	4
00111	3
00100	2
00101	1

**Table 2: PLL ND[4:0]**

### General Purpose ID register

There are 32 additional GPIO pins that are used to create a general purpose, user-defined ID register.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
gpio [41]	gpio [40]	gpio [39]	gpio [38]	gpio [37]	gpio [36]	gpio [35]	gpio [34]	gpio [33]	gpio [32]	gpio [31]	gpio [30]	gpio [29]	gpio [28]	gpio [27]	gpio [26]
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
gpio [25]	gpio [23]	gpio [22]	gpio [21]	gpio [18]	gpio [16]	gpio [15]	gpio [14]	gpio [13]	gpio [11]	gpio [09]	gpio [07]	gpio [06]	gpio [05]	gpio [03]	gpio [01]

These external signals are registered at powerup. Read these signals for general purpose status information.

## System boot

There are two ways to boot the NS9750B-A1 system:

- From a fast Flash over the system memory bus
- From an inexpensive, but slower, serial EEPROM through SPI port B

Both boot methods are glueless. The bootstrap pin, `RESET_DONEn`, indicates where to boot on a system powerup. Flash boot can be done from 8-bit, 16-bit, or 32-bit ROM or Flash.

Serial EEPROM boot is supported by NS9750B-A1 hardware. A configuration header in the EEPROM specifies total number of words to be fetched from EEPROM, as well as a system memory configuration and a memory controller configuration. The boot engine configures the memory controller and system memory, fetches data from low-cost serial EEPROM, and writes the data to external system memory, holding the CPU in reset, then enables the CPU.

## Reset

Master reset using an external reset pin resets NS9750B-A1. Only the AHB bus error status registers retain their values; software read resets these error status registers. The input reset pin can be driven by a system reset circuit or a simple power-on reset circuit.

### *RESET\_DONE as an input*

Used at bootup only:

- When set to 0, the system boots from SDRAM through the serial SPI EEPROM.
- When set to 1, the system boots from Flash/ROM. This is the default.

### *RESET\_DONE as an output*

Sets to 1, per Step 6 in the boot sequence:

If the system is booting from serial EEPROM through the SPI port, the boot program must be loaded into the SDRAM before the CPU is released from reset. The memory controller is powered up with `dy_cs_n[0]` enabled with a default set of SDRAM configurations. The default address range for `dy_cs_n[0]` is from `0x0000 0000`. The other chip selects are disabled.

### **SPI boot sequence**

- 1 When the system reset turns to inactive, the reset signal to the CPU is still held active.
- 2 An I/O module on the peripheral bus (BBus) reads from a serial ROM device that contains the memory controller settings and the boot program.
- 3 The BBus-to-AHB bridge requests and gets the system bus.

- 4 The memory controller settings are read from the serial EEPROM and used to initialize the memory controller.
- 5 The BBus-to-AHB bridge loads the boot program into the SDRAM, starting at address 0.
- 6 The reset signal going to the CPU is released once the boot program is loaded. RESET\_DONE is now set to 1.
- 7 The CPU begins to execute code from address 0x0000 0000.

You can use one of these software resets to reset the NS9750B-A1. Select the reset by setting the appropriate bit in the appropriate register:

- Watchdog timer can issue reset upon Watchdog timer expiration.
- Software reset can reset individual internal modules or all modules except memory and CPU.
- The system is reset whenever software sets the PLL SW change bit to 1.

Hardware reset duration is 4ms for PLL to stabilize. Software reset duration depends on speed grade, as shown in Table 3.

Speed grade	CPU clock cycles	Duration
200 MHz	128	640 ns
162 MHz	128	790 ns
125 MHz	128	1024 ns

**Table 3: Software reset duration**

The minimum reset pulse width is 10 crystal clocks.

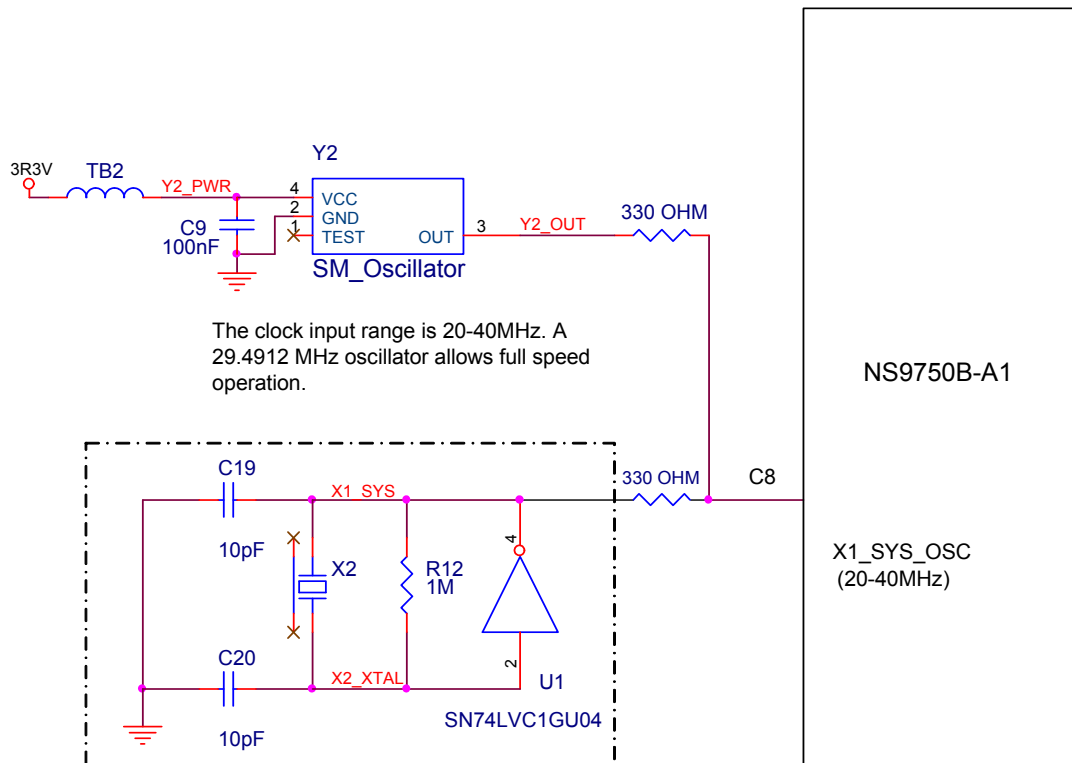
## System Clock

The system clock reference is provided to the NS9750B-A1 by an external oscillator; Table 4 shows sample clock frequency settings for each chip speed grade.

Speed	cpu_clk	hclk (main bus)	bbus_clk
200 MHz	200 (199.0656)	99.5328	49.7664
162 MHz	162.2016	81.1008	40.5504
125 MHz	125.3376	62.6688	31.3344

**Table 4: Sample clock frequency settings with 29.4912 MHz oscillator**

The oscillator must be connected to the x1\_sys\_osc input (C8 pin) on the NS9750B-A1, as shown in Figure 2.



**Figure 2: NS9750B-A1 system clock**

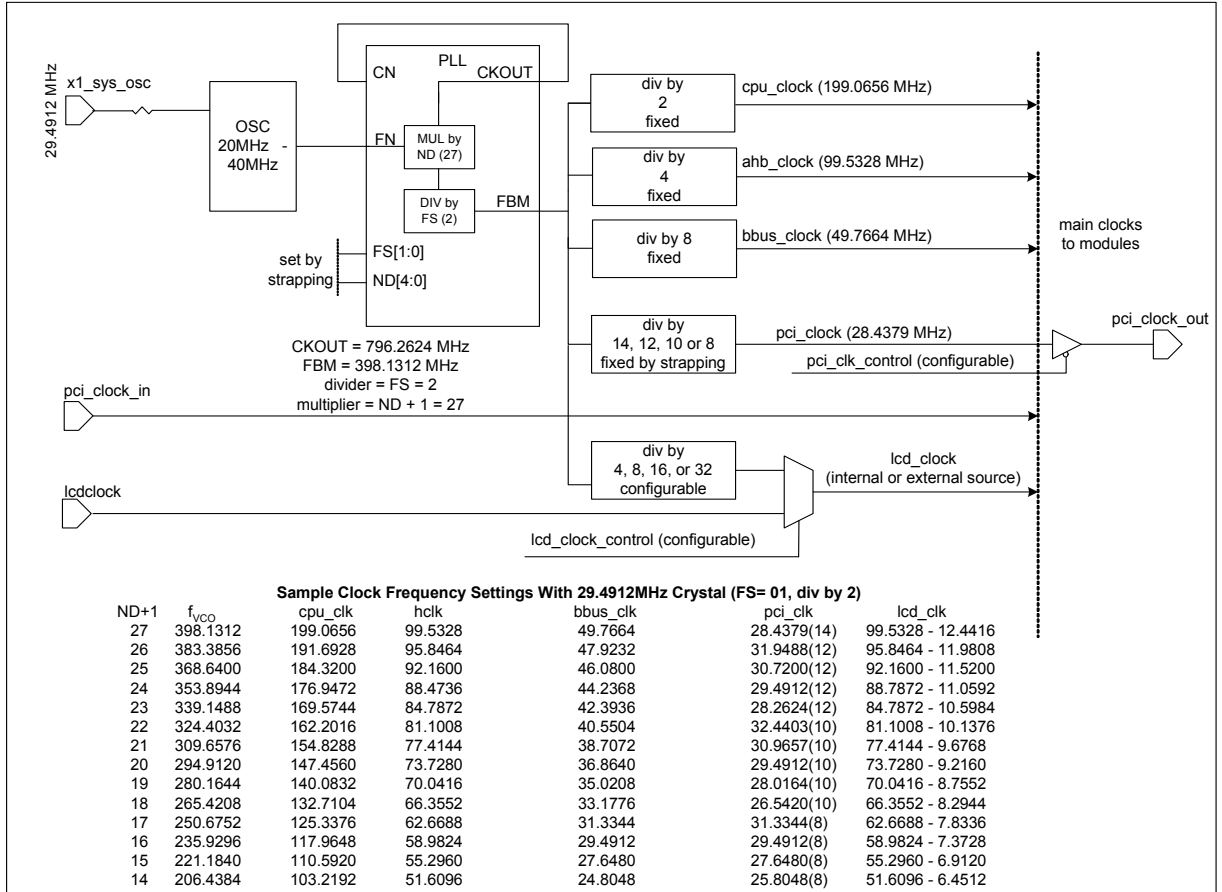
The PLL parameters are initialized on powerup reset and can be changed by software from  $f_{max}$  to  $1/2 f_{max}$ . For a 200 MHz grade, then, the CPU may change from 200 MHz to 100 MHz, the AHB system bus may change from 100 MHz to 50 MHz, and the peripheral BBus may change from 50 MHz to 25 MHz. If changed by software, the system resets automatically after the PLL stabilizes (approximately 4 ms).

The system clock provides clocks for CPU, AHB system bus, peripheral BBus, PCI/CardBus, LCD, timers, memory controller, and BBus modules (serial modules and 1284 parallel port).

The Ethernet MAC uses external clocks from a MII PHY or a RMII PHY. For a MII PHY, these clocks are input signals: `rx_clk` on pin T3 for receive clock and `tx_clk` on pin V3 for transmit clock. For a RMII, there is only one clock, and it connects to the `rx_clk` on pin T3. In this case, the transmit clock `tx_clk`, pin V3, should be tied low.

PCI/CardBus, LCD controller, serial modules (UART, SPI), and 1284 port can optionally use external clock signals.

Figure 3 shows how the PLL clock is used to provide the NS9750B-A1 system clocks.



**Figure 3: NS9750B-A1 system clock generation (PLL)**

You can use this formula to calculate the system clock frequencies if a different system oscillator frequency is used:

$$\begin{aligned}
 f_{vco} &= (f_{osc} \times (ND + 1) / FS) \\
 f_{cpu\_clk} &= f_{vco} / 2 \\
 f_{hclk} &= f_{vco} / 4 \\
 f_{bbus\_clk} &= f_{vco} / 8 \\
 f_{pci\_clk} &= f_{vco} / 14, 12, 10 \text{ or } 8 \\
 f_{lcd\_clk} &= \text{programmable, } f_{vco} / 4, 8, 16, \text{ or } 32
 \end{aligned}$$

## USB clock

USB is clocked by a separate PLL driven by an external 48 MHz crystal, or it can be driven directly by an external 48 MHz oscillator. Figure 4 shows a USB circuit.

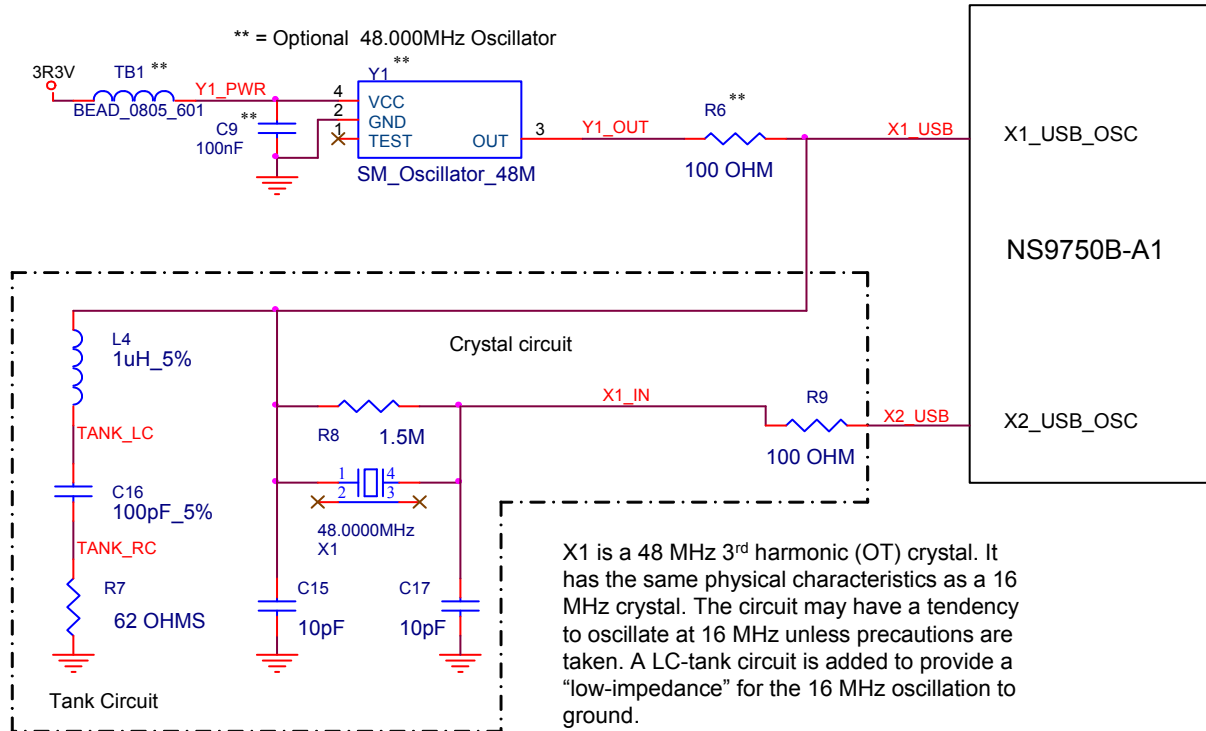


Figure 4: USB clock

## NS9750B-A1 pinout and signal descriptions

Each pinout table applies to a specific interface, and contains the following information:

Heading	Description
Pin #	The pin number assignment for a specific I/O signal.
Signal Name	The pin name for each I/O signal. Some signals have multiple function modes and are identified accordingly. The mode is configured through firmware using one or more configuration registers. _n in the signal name indicates that this signal is active <i>low</i> .
U/D	U or D indicates whether the pin is a pullup resistor or a pulldown resistor: <ul style="list-style-type: none"> <li>■ U — Pullup (input current source)</li> <li>■ D — Pulldown (input current sink)</li> </ul> If no value appears, that pin is neither a pullup nor pulldown resistor.
I/O	The type of signal — input, output, or input/output.
OD (mA)	The output drive strength of an output buffer. The NS9750B-A1 uses one of three drivers: <ul style="list-style-type: none"> <li>■ 2 mA</li> <li>■ 4 mA</li> <li>■ 8 mA</li> </ul>

More detailed signal descriptions are provided for selected modules.

### System Memory interface

Pin #	Signal Name	U/D	OD (mA)	I/O	Description
A21	addr[0]		8	O	Address bus signal
B20	addr[1]		8	O	Address bus signal
C19	addr[2]		8	O	Address bus signal
A20	addr[3]		8	O	Address bus signal
B19	addr[4]		8	O	Address bus signal
C18	addr[5]		8	O	Address bus signal
A19	addr[6]		8	O	Address bus signal
A17	addr[7]		8	O	Address bus signal
C16	addr[8]		8	O	Address bus signal
B16	addr[9]		8	O	Address bus signal
A16	addr[10]		8	O	Address bus signal
D15	addr[11]		8	O	Address bus signal

**Table 5: System Memory interface pinout**

## System Memory interface

Pin #	Signal Name	U/D	OD (mA)	I/O	Description
C15	addr[12]		8	O	Address bus signal
B15	addr[13]		8	O	Address bus signal
A15	addr[14]		8	O	Address bus signal
C14	addr[15]		8	O	Address bus signal
B14	addr[16]		8	O	Address bus signal
A14	addr[17]		8	O	Address bus signal
A13	addr[18]		8	O	Address bus signal
B13	addr[19]		8	O	Address bus signal
C13	addr[20]		8	O	Address bus signal
A12	addr[21]		8	O	Address bus signal
B12	addr[22]		8	O	Address bus signal
C12	addr[23]		8	O	Address bus signal
D12	addr[24]		8	O	Address bus signal
A11	addr[25]		8	O	Address bus signal
B11	addr[26]		8	O	Address bus signal
C11	addr[27]		8	O	Address bus signal
G2	clk_en[0]		8	O	SDRAM clock enable
H3	clk_en[1]		8	O	SDRAM clock enable
G1	clk_en[2]		8	O	SDRAM clock enable
H2	clk_en[3]		8	O	SDRAM clock enable
A10	clk_out[0]		8	O	SDRAM reference clock. Connect to clk_in using series termination.
A9	clk_out[1]		8	O	SDRAM clock
A5	clk_out[2]		8	O	SDRAM clock
A4	clk_out[3]		8	O	SDRAM clock
G26	data[0]		8	I/O	Data bus signal
H24	data[1]		8	I/O	Data bus signal
G25	data[2]		8	I/O	Data bus signal
F26	data[3]		8	I/O	Data bus signal
G24	data[4]		8	I/O	Data bus signal
F25	data[5]		8	I/O	Data bus signal
E26	data[6]		8	I/O	Data bus signal

**Table 5: System Memory interface pinout**

Pin #	Signal Name	U/D	OD (mA)	I/O	Description
F24	data[7]		8	I/O	Data bus signal
E25	data[8]		8	I/O	Data bus signal
D26	data[9]		8	I/O	Data bus signal
F23	data[10]		8	I/O	Data bus signal
E24	data[11]		8	I/O	Data bus signal
D25	data[12]		8	I/O	Data bus signal
C26	data[13]		8	I/O	Data bus signal
E23	data[14]		8	I/O	Data bus signal
D24	data[15]		8	I/O	Data bus signal
C25	data[16]		8	I/O	Data bus signal
B26	data[17]		8	I/O	Data bus signal
D22	data[18]		8	I/O	Data bus signal
C23	data[19]		8	I/O	Data bus signal
B24	data[20]		8	I/O	Data bus signal
A25	data[21]		8	I/O	Data bus signal
C22	data[22]		8	I/O	Data bus signal
D21	data[23]		8	I/O	Data bus signal
B23	data[24]		8	I/O	Data bus signal
A24	data[25]		8	I/O	Data bus signal
A23	data[26]		8	I/O	Data bus signal
B22	data[27]		8	I/O	Data bus signal
C21	data[28]		8	I/O	Data bus signal
A22	data[29]		8	I/O	Data bus signal
B21	data[30]		8	I/O	Data bus signal
C20	data[31]		8	I/O	Data bus signal
E1	data_mask[0]		8	O	SDRAM data mask signal
F2	data_mask[1]		8	O	SDRAM data mask signal
G3	data_mask[2]		8	O	SDRAM data mask signal
F1	data_mask[3]		8	O	SDRAM data mask signal
C5	clk_in			I	SDRAM feedback clock. Connect to clk_out[0].
B4	byte_lane_sel_n[0]		8	O	Static memory byte_lane_enable[0] or write_enable_n[0] for byte-wide device signals

**Table 5: System Memory interface pinout**

## System Memory interface

Pin #	Signal Name	U/D	OD (mA)	I/O	Description
F4	byte_lane_sel_n[1]		8	O	Static memory byte_lane_enable[1] or write_enable_n[1] for byte-wide device signals
D1	byte_lane_sel_n[2]		8	O	Static memory byte_lane_enable[2] or write_enable_n[2] for byte-wide device signals
F3	byte_lane_sel_n[3]		8	O	Static memory byte_lane_enable[3] or write_enable_n[3] for byte-wide device signals
B5	cas_n		8	O	SDRAM column address strobe
A8	dy_cs_n[0]		8	O	SDRAM chip select signal
B8	dy_cs_n[1]		8	O	SDRAM chip select signal
A6	dy_cs_n[2]		8	O	SDRAM chip select signal
C7	dy_cs_n[3]		8	O	SDRAM chip select signal
C6	st_oe_n		8	O	Static memory output enable
D6	ras_n		8	O	SDRAM row address strobe
H1	dy_pwr_n		8	O	SyncFlash power down
B10	st_cs_n[0]		8	O	Static memory chip select signal
C10	st_cs_n[1]		8	O	Static memory chip select signal
B9	st_cs_n[2]		8	O	Static memory chip select signal
C9	st_cs_n[3]		8	O	Static memory chip select signal
B6	we_n		8	O	SDRAM write enable. Used for static and SDRAM devices.
J3	ta_strb	U		I	Slow peripheral transfer acknowledge

**Table 5: System Memory interface pinout**

## System Memory interface signals

Table 6 describes the System Memory interface signals in more detail. All signals are internal to the chip.

Name	I/O	Description
addr[27:0]	O	Address output. Used for both static and SDRAM devices. SDRAM memories use bits [14:0]; static memories use bits [25:0].
clk_en[3:0]	O	SDRAM clock enable. Used for SDRAM devices. <b>Note:</b> The clk_en signals are associated with the dy_cs_n signals.
clk_out[3:1]	O	SDRAM clocks. Used for SDRAM devices.
clk_out[0]	O	SDRAM clk_out[0] is connected to clk_in.
data[31:0]	I/O	Data to/from memory. Used for the static memory controller and the dynamic memory controller.
data_mask[3:0]	O	Data mask output to SDRAMs. Used for SDRAM devices.
clk_in	I	Feedback clock. Always connects to clk_out[0].
byte_lane_sel_n[3:0]	O	Static memory byte lane select, active low, or write_enable_n for byte-wide devices.
cas_n	O	Column address strobe. Used for SDRAM devices.
dy_cs_n[3:0]	O	SDRAM chip selects. Used for SDRAM devices.
st_oe_n	O	Output enable for static memories. Used for static memory devices.
ras_n	O	Row address strobe. Used for SDRAM devices.
st_cs_n[3:0]	O	Static memory chip selects. Default active low. Used for static memory devices.
we_n	O	Write enable. Used for SDRAM and static memories.
ta_strb	I	<i>Slow peripheral transfer acknowledge</i> can be used to terminate static memory cycles sooner than the number of wait states programmed in the chip select setup register.

**Table 6: System Memory interface signal descriptions**

Figure 5 shows NS9750B-A1 SDRAM clock termination.

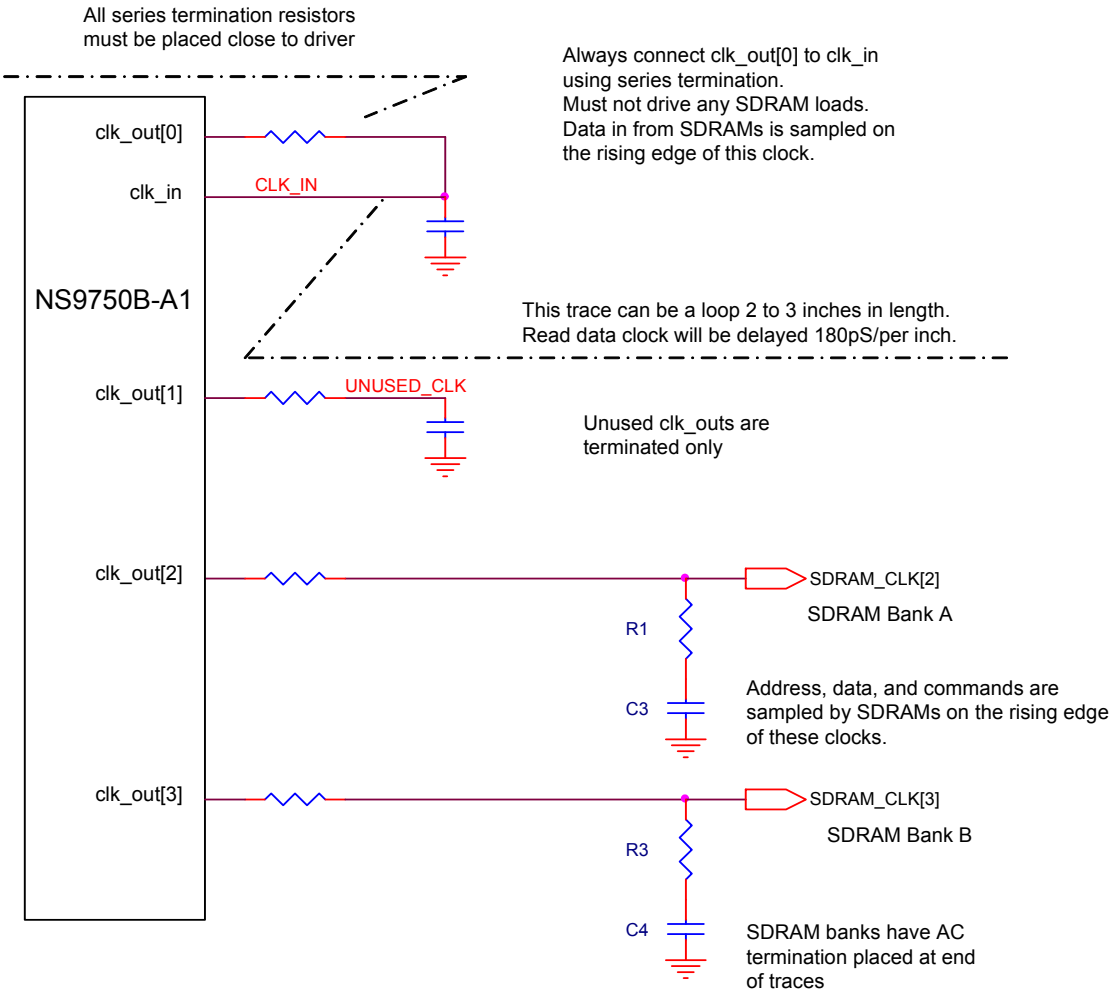


Figure 5: SDRAM clock termination

## Ethernet interface

Pin #	Signal name		U/D	OD (mA)	I/O	Description	
	MII	RMII				MII	RMII
AB1	col	N/C			I	Collision	Pull low external to NS9750B-A1
AA2	crs	crs_dv			I	Carrier sense	Carrier sense
AC1	enet_phy_int_n	enet_phy_int_n	U		I	Ethernet PHY interrupt	Ethernet PHY interrupt
AA3	mdc	mdc		4	O	MII management interface clock	MII management interface clock
AB2	mdio	mdio	U	2	I/O	MII management data	MII management data
T3	rx_clk	ref_clk			I	Receive clock	Reference clock
V2	rx_dv	N/C			I	Receive data valid	Pull low external to NS9750B-A1
W1	rx_er	rx_er			I	Receive error	Optional signal; pull low to NS9750B-A1 if not used.
V1	rx_d[0]	rx_d[0]			I	Receive data bit 0	Receive data bit 0
U3	rx_d[1]	rx_d[1]			I	Receive data bit 1	Receive data bit 1
U2	rx_d[2]	N/C			I	Receive data bit 2	Pull low external to NS9750B-A1
U1	rx_d[3]	N/C			I	Receive data bit 3	Pull low external to NS9750B-A1
V3	tx_clk	N/C			I	Transmit clock	Pull low external to NS9750B-A1
AA1	tx_en	tx_en		2	O	Transmit enable	Transmit enable
Y3	tx_er	N/C		2	O	Transmit error	N/A
Y2	tx_d[0]	tx_d[0]		2	O	Transmit data bit 0	Transmit data bit 0
W3	tx_d[1]	tx_d[1]		2	O	Transmit data bit 1	Transmit data bit 1
Y1	tx_d[2]	N/C		2	O	Transmit data bit 2	N/A
W2	tx_d[3]	N/C		2	O	Transmit data bit 3	N/A

Table 7: Ethernet interface pinout

## Clock generation/system pins

Pin #	Signal name	U/D	OD (mA)	I/O	Description
C8	x1_sys_osc			I	System clock oscillator circuit input
D9	x1_usb_osc			I	USB clock crystal oscillator circuit input. (Connect to GND if USB is not used.)
A7	x2_usb_osc			O	USB clock crystal oscillator circuit output
AC21	reset_done	U	2	I/O	CPU is enabled once the boot program is loaded. Reset_done is set to 1.
H25	reset_n	U		I	System reset input signal.
AD20	bist_en_n			I	Enable internal BIST operation
AF21	pll_test_n			I	Enable PLL testing
AE21	scan_en_n			I	Enable internal scan testing
B18	sys_pll_dvdd				System clock PLL 1.5V digital power
A18	sys_pll_dvss				System clock PLL digital ground
B17	sys_pll_avdd				System clock PLL 3.3V analog power
C17	sys_pll_avss				System clock PLL analog ground
J2	lcdclk	U		I	External LCD clock input
D2	sreset_n			I	System reset. sreset_n is the same as reset, but does not reset the system PLL.
E3	sreset_n_enable			I	<ul style="list-style-type: none"> <li>■ Tie to 3.3V to enable the sreset_n input.</li> <li>■ Tie to ground to disable the sreset_n input.</li> </ul>
T2	boot_strap[0]	U	2	I/O	Chip select 1 static memory byte_lane_enable_n, or write_enable_n for byte-wide devices bootstrap select
N3	boot_strap[1]	U	2	I/O	CardBus mode bootstrap select
P1	boot_strap[2]	U	2	I/O	Memory interface read mode bootstrap select
P2	boot_strap[3]	U	2	I/O	Chip select 1 data width bootstrap select
P3	boot_strap[4]	U	2	I/O	Chip select 1 data width bootstrap select

Table 8: Clock generation/system pins pinout

## bist\_en\_n, pll\_test\_n, and scan\_en\_n

Table 9 is a truth/termination table for bist\_en\_n, pll\_test\_n, and scan\_en\_n.

	Normal operation	Arm debug	
pll_test_n	pull up	pull up	10K recommended
bist_en_n	pull down	pull up	10K pullup = debug 2.4K pulldown = normal
scan_en_n	pull down	pull down	2.4K recommended

**Table 9: bist\_en\_n, pll\_test\_n, & scan\_en\_n truth/termination table**

## PCI interface

The PCI interface can be set to PCI host or PCI device (slave) using the pci\_central\_resource\_n pin.

### Notes:

- All output drivers for PCI meet the standard PCI driver specification.
- All table notes can be found after Table 11: CardBus IO muxed signals.

Pin #	Signal Name	OD		Description
		U/D	(mA)	
J24	ad[0] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
H26	ad[1] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
J25	ad[2] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
J26	ad[3] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
K24	ad[4] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
K25	ad[5] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
K26	ad[6] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
L24	ad[7] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
L26	ad[8] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
M24	ad[9] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
M25	ad[10] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
M26	ad[11] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
N24	ad[12] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
N25	ad[13] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
N26	ad[14] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
P26	ad[15] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus
U24	ad[16] <sup>1</sup>	N/A	I/O	PCI time-multiplexed address/data bus

**Table 10: PCI interface pinout**

Pin #	Signal Name	U/D	OD (mA)	I/O	Description
V26	ad[17] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
V25	ad[18] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
W26	ad[19] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
V24	ad[20] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
W25	ad[21] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
Y26	ad[22] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
W24	ad[23] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
Y24	ad[24] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AA25	ad[25] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AB26	ad[26] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AA24	ad[27] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AB25	ad[28] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AC26	ad[29] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AD26	ad[30] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
AC25	ad[31] <sup>1</sup>		N/A	I/O	PCI time-multiplexed address/data bus
L25	cbe_n[0] <sup>1</sup>		N/A	I/O	Command/byte enable
P25	cbe_n[1] <sup>1</sup>		N/A	I/O	Command/byte enable
U25	cbe_n[2] <sup>1</sup>		N/A	I/O	Command/byte enable
AA26	cbe_n[3] <sup>1</sup>		N/A	I/O	Command/byte enable
T26	devsel_n <sup>2</sup>		N/A	I/O	Device select
U26	frame_n <sup>2</sup>		N/A	I/O	Cycle frame
Y25	idsel <sup>3,4</sup>		N/A	I	Initialization device select: <ul style="list-style-type: none"> <li>■ For PCI host applications, connect to AD11.</li> <li>■ For PCI device applications, connection is determined by the PCI device number assigned to the NS9750B-A1.</li> <li>■ For CardBus applications, connect to external pullup resistor.</li> <li>■ Do not allow input to float in any application.</li> </ul>
T24	irdy_n <sup>2</sup>		N/A	I/O	Initiator ready
P24	par <sup>1</sup>		N/A	I/O	Parity signal
R25	perr_n <sup>2</sup>		N/A	I/O	Parity error

Table 10: PCI interface pinout

Pin #	Signal Name	U/D	OD (mA)	I/O	Description
R26	serr_n <sup>2</sup>		N/A	I/O	System error: Input: pci_central_resource_n = 0 Output: pci_central_resource_n = 1
R24	stop_n <sup>2</sup>		N/A	I/O	Stop signal
T25	trdy_n <sup>2</sup>		N/A	I/O	Target ready
AC24	pci_arb_gnt_1_n <sup>6</sup>		N/A	O	PCI channel 1 grant
AD23	pci_arb_gnt_2_n <sup>6</sup>		N/A	O	PCI channel 2 grant
AE24	pci_arb_gnt_3_n <sup>6</sup>		N/A	O	PCI channel 3 grant
AD25	pci_arb_req_1_n <sup>2</sup>		N/A	I	PCI channel 1 request
AB23	pci_arb_req_2_n <sup>2</sup>		N/A	I	PCI channel 2 request
AC22	pci_arb_req_3_n <sup>2</sup>		N/A	I	PCI channel 3 request
AF23	pci_central_resource_n	D	N/A	I	PCI internal central resource enable
AF25	pci_int_a_n <sup>2</sup>		N/A	I/O	PCI interrupt request A, output if external central resource used
AF24	pci_int_b_n <sup>2</sup>		N/A	I/O	PCI interrupt request B, CCLKRUN# for CardBus applications
AE23	pci_int_c_n <sup>2</sup>		N/A	I	PCI interrupt request C
AD22	pci_int_d_n <sup>2</sup>		N/A	I	PCI interrupt request D
AE26	pci_reset_n <sup>3</sup>		N/A	I/O	PCI reset, output if internal central resource enabled
AB24	pci_clk_in	U	N/A	I	PCI clock in. (Connected to pci_clk_out or an externally generated PCI reference clock.)
AA23	pci_clk_out		N/A	O	PCI clock out

**Table 10: PCI interface pinout**

## PCI/CardBus signals

Most of the CardBus signals are the same as the PCI signals. Other CardBus signals are unique and multiplexed with PCI signals for the NS9750B-A1. Table 11 shows these unique signals.

PCI signal	CardBus signal	CardBus type	Description
INTA#	CINT# <sup>4</sup>	Input	CardBus interrupt pin. The INTA2PCI pin in the PCI Miscellaneous Support register must be set to 0.
INTB#	CCLKRUN# <sup>4</sup>	Bidir	CardBus pin used to negotiate with the external CardBus device before stopping the clock. Allows external CardBus device to request that the clock be restarted.

**Table 11: CardBus IO muxed signals**

PCI signal	CardBus signal	CardBus type	Description
INTC#	CSTSCHG <sup>5</sup>	Input	CardBus status change interrupt signal.
GNT1#	CGNT# <sup>4</sup>	Output	Grant to external CardBus device from NS9750B-A1's internal arbiter.
GNT2#	CVS1	Output	Voltage sense pin. Normally driven low by NS9750B-A1, but toggled during interrogation of the external CardBus device to find voltage requirements. <b>Note:</b> Do not connect directly to the CardBus connector. See the diagram "CardBus system connections to NS9750B-A1" in the <i>NS9750B-A1 Hardware Reference</i> .
GNT3#	CVS2	Output	Voltage sense pin. Normally driven low by NS9750B-A1, but toggled during interrogation of the external CardBus device to find voltage requirements.
REQ1#	CREQ# <sup>4</sup>	Input	Request from external CardBus device to NS9750B-A1's internal arbiter.
REQ2#	CCD1 <sup>4</sup>	Input	Card detect pin. Pulled up when the socket is empty and pulled low when the external CardBus device is in the socket.
REQ3#	CCD2 <sup>4</sup>	Input	Card detect pin. Pulled up when the socket is empty and pulled low when the external CardBus device is in the socket.

**Table 11: CardBus IO muxed signals**

**Notes:**

- 1 Add external pulldown resistor or drive with the NS9750B-A1 *only* if the PCI interface is not being used. Figure 6, "NS9750B-A1 unused PCI termination," shows which signals can be driven by the NS9750B-A1 and which signals require pullups or pulldowns.
- 2 Add external pullup resistors *regardless* of whether the PCI interface is being used.
- 3 Add external pullup resistor *only* if the PCI interface is not being used.
- 4 Add external pullup resistor in CardBus mode.
- 5 Add external pulldown resistor in CardBus mode.
- 6 Add external pullup *only* if the PCI interface is being used and this signal is also being used.

Figure 6 shows how to terminate an unused PCI.

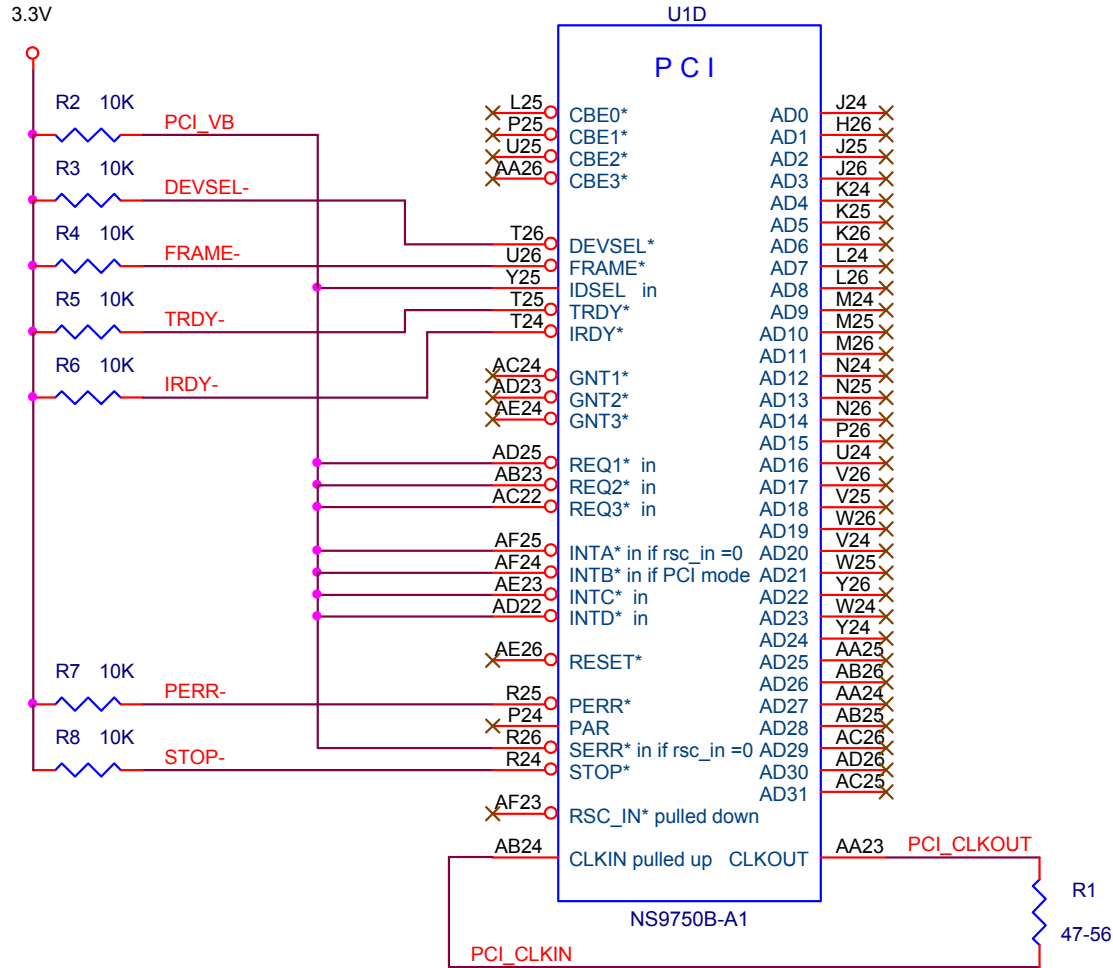


Figure 6: NS9750B-A1 unused PCI termination

Notes:

- Startup code needs to put the PCI bridge into reset.
- PCI Mode: Boot\_strap[1]. N3 = default; no pulldown.
- NS9750B-A1 is the current PCI bus master. Signals that it can drive should have individual pullups.

## GPIO MUX

- The BBus utility contains the control pins for each GPIO MUX bit. Each pin can be selected individually; that is, you can select any option (00, 01, 02, 03) for any pin, by setting the appropriate bit in the appropriate register.
- Some signals are muxed to two different GPIO pins, to maximize the number of possible applications. These duplicate signals are marked as such in the Descriptions column in the table. Selecting the primary GPIO pin and the duplicate GPIO pin for the same function is not recommended. If both the primary GPIO pin and duplicate GPIO pin are programmed for the same function, however, the primary GPIO pin has precedence and will be used.
- The 00 option for the serial ports (B, A, C, and D) are configured for UART and SPI mode, respectively; that is, the UART option is shown first, followed by the SPI option if there is one. If only one value appears, it is the UART mode value. SPI options all begin with *SPI*.

Pin #	Signal name	U/D	OD (mA)	I/O	Descriptions (4 options: 00, 01, 02, 03)
AF19	gpio[0] <sup>1</sup>	U	2	I/O	00 Ser port B TxData / SPI port B dout 01 DMA ch 1 done (duplicate) 02 Timer 1 (duplicate) 03 GPIO 0
AE18	gpio[1]	U	2	I/O	00 Ser port B RxData / SPI port B din 01 DMA ch 1 req (duplicate) 02 Ext IRQ 0 03 GPIO 1
AF18	gpio[2] <sup>1</sup>	U	2	I/O	00 Ser port B RTS 01 Timer 0 02 DMA ch 2 read enable 03 GPIO 2
AD17	gpio[3]	U	2	I/O	00 Ser port B CTS 01 1284 nAck (peripheral-driven) 02 DMA ch 1 req 03 GPIO 3
AE17	gpio[4] <sup>1</sup>	U	2	I/O	00 Ser port B DTR 01 1284 busy (peripheral-driven) 02 DMA ch 1 done 03 GPIO 4
AF17	gpio[5]	U	2	I/O	00 Ser port B DSR 01 1284 PError (peripheral-driven) 02 DMA ch 1 read enable 03 GPIO 5

**Table 12: GPIO MUX pinout**

Pin #	Signal name	U/D	OD (mA)	I/O	Descriptions (4 options: 00, 01, 02, 03)
AD16	gpio[6]	U	2	I/O	00 Ser port B RI / SPI port B clk 01 1284 nFault (peripheral-driven) <sup>1</sup> 02 Timer 7 (duplicate) 03 GPIO 6
AE16	gpio[7]	U	2	I/O	00 Ser port B DCD / SPI port B enable 01 DMA ch 1 read enable (duplicate) 02 Ext IRQ 1 03 GPIO 7
AD15	gpio[8] <sup>1</sup>	U	2	I/O	00 Ser port A TxData / SPI port A dout 01 Reserved 02 Reserved 03 GPIO 8
AE15	gpio[9]	U	2	I/O	00 Ser port A RxData / SPI port A din 01 Reserved 02 Timer 8 (duplicate) 03 GPIO 9
AF15	gpio[10] <sup>1</sup>	U	2	I/O	00 Ser port A RTS 01 Reserved 02 Reserved 03: GPIO 10
AD14	gpio[11]	U	2	I/O	00 Ser port A CTS 01 Ext IRQ2 (duplicate) 02 Timer 0 (duplicate) 03 GPIO 11
AE14	gpio[12] <sup>1</sup>	U	2	I/O	00 Ser port A DTR 01 Reserved 02 Reserved 03 GPIO 12
AF14	gpio[13]	U	2	I/O	00 Ser port A DSR 01 Ext IRQ 0 (duplicate) 02 Timer 10 (duplicate) 03 GPIO 13
AF13	gpio[14]	U	2	I/O	00 Ser port A RI / SPI port A clk 01 Timer 1 02 Reserved 03 GPIO 14
AE13	gpio[15]	U	2	I/O	00 Ser port A DCD / Ser port A enable 01 Timer 2 02 Reserved 03 GPIO 15

Table 12: GPIO MUX pinout

Pin #	Signal name	U/D	OD (mA)	I/O	Descriptions (4 options: 00, 01, 02, 03)
AD13	gpio[16] <sup>2</sup>	U	2	I/O	00 Reserved output 01 1284 nFault (peripheral-driven, duplicate) <sup>3</sup> 02 Timer 11 (duplicate) or USB OVR 03 GPIO 16
AF12	gpio[17] <sup>1,2</sup>	U	2	I/O	00 USB power relay 01 Reserved 02 Reserved 03 GPIO 17
AE12	gpio[18]	U	4	I/O	00 Ethernet CAM reject 01 LCD power enable 02 Ext IRQ 3 (duplicate) 03 GPIO 18
AD12	gpio[19] <sup>1</sup>	U	4	I/O	00 Ethernet CAM req 01 LCD line-horz sync 02 DMA ch 2 read enable (duplicate) 03 GPIO 19
AC12	gpio[20] <sup>1</sup>	U	8	I/O	00 Ser port C DTR 01 LCD clock 02 Reserved 03 GPIO 20
AF11	gpio[21]	U	4	I/O	00 Ser port C DSR 01 LCD frame pulse-vert 02 Reserved 03 GPIO 21
AE11	gpio[22]	U	4	I/O	00 Ser port C RI / SPI port C clk 01 LCD AC bias-data enable 02 Reserved 03 GPIO 22
AD11	gpio[23]	U	4	I/O	00 Ser port C DCD / SPI port C enable 01 LCD line end 02 Timer 14 (duplicate) 03 GPIO 23
AF10	gpio[24] <sup>1</sup>	U	4	I/O	00 Ser port D DTR 01 LCD data bit 0 02 Reserved 03 GPIO 24
AE10	gpio[25]	U	4	I/O	00 Ser port D DSR 01 LCD data bit 1 02 Timer 15 (duplicate) 03 GPIO 25

**Table 12: GPIO MUX pinout**

Pin #	Signal name	U/D	OD (mA)	I/O	Descriptions (4 options: 00, 01, 02, 03)
AD10	gpio[26]	U	4	I/O	00 Ser port D RI / SPI port D clk 01 LCD data bit 2 02 Timer 3 03 GPIO 26
AF9	gpio[27]	U	4	I/O	00 Ser port D DCD / SPI port D enable 01 LCD data bit 3 02 Timer 4 03 GPIO 27
AE9	gpio[28]	U	4	I/O	00 Ext IRQ 1 (duplicate) 01 LCD data bit 4 02 LCD data bit 8 (duplicate) 03 GPIO 28
AF8	gpio[29]	U	4	I/O	00 Timer 5 01 LCD data bit 5 02 LCD data bit 9 (duplicate) 03 GPIO 29
AD9	gpio[30]	U	4	I/O	00 Timer 6 01 LCD data bit 6 02 LCD data bit 10 (duplicate) 03 GPIO 30
AE8	gpio[31]	U	4	I/O	00 Timer 7 01 LCD data bit 7 02 LCD data bit 11 (duplicate) 03 GPIO 31
AF7	gpio[32]	U	4	I/O	00 Ext IRQ 2 01 1284 Data 1 (bidirectional) 02 LCD data bit 8 03 GPIO 32
AD8	gpio[33]	U	4	I/O	00 Timer 8 01 1284 Data 2 (bidirectional) 02 LCD data bit 9 03 GPIO 33
AD7	gpio[34]	U	4	I/O	00 Timer 9 01 1284 Data 3 (bidirectional) 02 LCD data bit 10 03 GPIO 34
AE6	gpio[35]	U	4	I/O	00 Timer 10 01 1284 Data 4 (bidirectional) 02 LCD data bit 11 03 GPIO 35

**Table 12: GPIO MUX pinout**

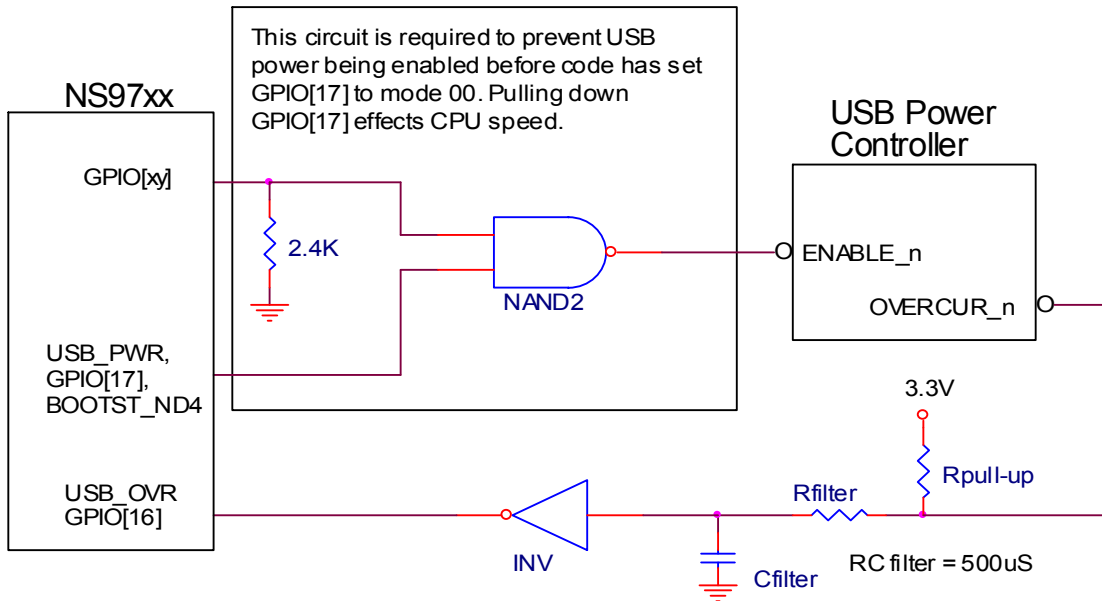
Pin #	Signal name	U/D	OD (mA)	I/O	Descriptions (4 options: 00, 01, 02, 03)
AF5	gpio[36]	U	4	I/O	00 Reserved 01 1284 Data 5 (bidirectional) 02 LCD data bit 12 03 GPIO 36
AD6	gpio[37]	U	4	I/O	00 Reserved 01 1284 Data 6 (bidirectional) 02 LCD data bit 13 03 GPIO 37
AE5	gpio[38]	U	4	I/O	00 Reserved 01 1284 Data 7 (bidirectional) 02 LCD data bit 14 03 GPIO 38
AF4	gpio[39]	U	4	I/O	00 Reserved 01 1284 Data 8 (bidirectional) 02 LCD data bit 15 03 GPIO 39
AC6	gpio[40]	U	4	I/O	00 Ser port C TxData / SPI port C dout 01 Ext IRQ 3 02 LCD data bit 16 03 GPIO 40
AD5	gpio[41]	U	4	I/O	00 Ser port C RxData / SPI port C din 01 Timer 11 02 LCD data bit 17 03 GPIO 41
AE4	gpio[42]	U	4	I/O	00 Ser port C RTS 01 Timer 12 02 LCD data bit 18 03 GPIO 42
AF3	gpio[43]	U	4	I/O	00 Ser port C CTS 01 Timer 13 02 LCD data bit 19 03 GPIO 43
AD2	gpio[44] <sup>1</sup>	U	4	I/O	00 Ser port D TxData / SPI port D dout 01 1284 Select (peripheral-driven) 02 LCD data bit 20 03 GPIO 44
AE1	gpio[45]	U	4	I/O	00 Ser port D RxData / SPI port D din 01 1284 nStrobe (host-driven) 02 LCD data bit 21 03 GPIO 45

**Table 12: GPIO MUX pinout**

Pin #	Signal name	U/D	OD (mA)	I/O	Descriptions (4 options: 00, 01, 02, 03)
AB3	gpio[46]	U	4	I/O	00 Ser port D RTS 01 1284 nAutoFd (host-driven) 02 LCD data bit 22 03 GPIO 46
AA4	gpio[47]	U	4	I/O	00 Ser port D CTS 01 1284 nInit (host-driven) 02 LCD data bit 23 03 GPIO 47
AC2	gpio[48]	U	2	I/O	00 Timer 14 01 1284 SelectIn (host-driven) 02 DMA ch 2 req 03 GPIO 48
AD1	gpio[49] <sup>1</sup>	U	2	I/O	00 Timer 15 01 1284 peripheral logic high (peripheral-driven) 02 DMA ch 2 done 03 GPIO 49

- <sup>1</sup> This pin is used for bootstrap initialization (see Table 1, “Configuration pins— Bootstrap initialization,” on page 5). Note that the GPIO pins used as bootstrap pins have a defined powerup state that is required for the appropriate NS9750B-A1 configuration. If these GPIO pins are also used to control external devices (for example, power switch enable), the powerup state for the external device should be compatible with the bootstrap state. If the powerup state is not compatible with the bootstrap state, either select a different GPIO pin to control the external device or add additional circuitry to reach the proper powerup state to the external device.
- gpio[17] is used as both a bootstrap input pin for PLL\_ND and an output that controls a power switch for USB Host power. If the power switch needs to powerup in the inactive state, the enable to the power switch must be the same value as the bootstrap value for PLL\_ND; for example, if PLL\_ND requires high on gpio[17], a high true power switch must be selected. gpio[16] is used for USB\_OVR and should have a noise filter to prevent false indications of overcurrent, unless the USB power IC has this filter built in. See “Example: Implementing gpio[16] and gpio[17]” on page 32 for an illustration.
- The nFault signal GPIO6 or GPIO16 can be used as a code-controlled direction pin for the transceiver. The polarity cannot be altered inside the NS9750B-A1; an inverter will be required.

**Table 12: GPIO MUX pinout**

**Example: Implementing gpio[16] and gpio[17]****LCD module signals**

The LCD module signals are multiplexed with GPIO pins. They include seven control signals and up to 24 data signals. Table 13 describes the control signals. Table 14 and Table 15 provide details for the data signals.

Signal name	Type	Description
CLPOWER	Output	LCD panel power enable
CLLP	Output	Line synchronization pulse (STN) / horizontal synchronization pulse (TFT)
CLCP	Output	LCD panel clock
CLFP	Output	Frame pulse (STN) / vertical synchronization pulse (TFT)
CLAC	Output	STN AC bias drive or TFT data enable output
CLD[23:0]	Output	LCD panel data (see Table 14 and Table 15)
CLLE	Output	Line end signal

**Table 13: LCD module signal descriptions**

The CLD[23:0] signal has eight modes of operation:

- TFT 24-bit interface
- TFT 18-bit interface
- Color STN single panel
- Color STN dual panel
- 4-bit mono STN single panel
- 4-bit mono STN dual panel
- 8-bit mono STN single panel
- 8-bit mono STN dual panel

Table 14 shows which CLD[23:0] pins provide the pixel data to the STN panel for each mode of operation.

**Legend:**

- Ext pin = External pin
- CUSTN = Color upper panel STN, dual and/or single panel
- CLSTN = Color lower panel STN, single
- MUSTN = Mono upper panel STN, dual and/or single panel
- MLSTN = Mono lower panel STN, single
- N/A = not used
- 01 and 02 = The option number/position in the Description field of the GPIO mux pinout. See “GPIO MUX” on page 26 for more information.

Ext pin	GPIO pin & description	Color STN single panel	Color STN dual panel	4-bit mono STN single panel	4-bit mono STN dual panel	8-bit mono STN single panel	8-bit mono STN dual panel
CLD[23]	AA4=LCD data bit 23 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[22]	AB3=LCD data bit 22 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[21]	AE1=LCD data bit 21 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[20]	AD2=LCD data bit 20 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[19]	AF3=LCD data bit 19 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[18]	AE4=LCD data bit 18 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[17]	AD5=LCD data bit 17 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[16]	AC6=LCD data bit 16 (O2)	N/A	N/A	N/A	N/A	N/A	N/A
CLD[15]	AF4=LCD data bit 15 (O2)	N/A	CLSTN[0] <sup>1</sup>	N/A	N/A	N/A	MLSTN[0] <sup>1</sup>
CLD[14]	AE5=LCD data bit 14 (O2)	N/A	CLSTN[1]	N/A	N/A	N/A	MLSTN[1]
CLD[13]	AD6=LCD data bit 13 (O2)	N/A	CLSTN[2]	N/A	N/A	N/A	MLSTN[2]
CLD[12]	AF5=LCD data bit 12 (O2)	N/A	CLSTN[3]	N/A	N/A	N/A	MLSTN[3]

**Table 14: CLD[23:0] pin descriptions for STN display**

Ext pin	GPIO pin & description	Color STN single panel	Color STN dual panel	4-bit mono STN single panel	4-bit mono STN dual panel	8-bit mono STN single panel	8-bit mono STN dual panel
CLD[11]	AE6=LCD data bit 11 (O2) AE8=LCD data bit 11 (O2)	N/A	CLSTN[4]	N/A	MLSTN[0] <sup>1</sup>	N/A	MLSTN[4]
CLD[10]	AD7=LCD data bit 10 (O2) AD9=LCD data bit 10 (O2)	N/A	CLSTN[5]	N/A	MLSTN[1]	N/A	MLSTN[5]
CLD[9]	AD8=LCD data bit 9 (O2) AF8=LCD data bit 9 (O2)	N/A	CLSTN[6]	N/A	MLSTN[2]	N/A	MLSTN[6]
CLD[8]	AF7=LCD data bit 8 (O2) AE9=LCD data bit 8 (O2)	N/A	CLSTN[7]	N/A	MLSTN[3]	N/A	MLSTN[7]
CLD[7]	AE8=LCD data bit 7 (O1)	CUSTN[0] <sup>1</sup>	CUSTN[0] <sup>1</sup>	N/A	N/A	MUSTN[0]	MUSTN[0] <sup>1</sup>
CLD[6]	AD9=LCD data bit 6 (O1)	CUSTN[1]	CUSTN[1]	N/A	N/A	MUSTN[1]	MUSTN[1]
CLD[5]	AF8=LCD data bit 5 (O1)	CUSTN[2]	CUSTN[2]	N/A	N/A	MUSTN[2]	MUSTN[2]
CLD[4]	AE9=LCD data bit 4 (O1)	CUSTN[3]	CUSTN[3]	N/A	N/A	MUSTN[3]	MUSTN[3]
CLD[3]	AF9=LCD data bit 3 (O1)	CUSTN[4]	CUSTN[4]	MUSTN[0]	MUSTN[0] <sup>1</sup>	MUSTN[4]	MUSTN[4]
CLD[2]	AD10=LCD data bit 2 (O1)	CUSTN[5]	CUSTN[5]	MUSTN[1]	MUSTN[1]	MUSTN[5]	MUSTN[5]
CLD[1]	AE10=LCD data bit 1 (O1)	CUSTN[6]	CUSTN[6]	MUSTN[2]	MUSTN[2]	MUSTN[6]	MUSTN[6]
CLD[0]	AF10=LCD data bit 0 (O1)	CUSTN[7]	CUSTN[7]	MUSTN[3]	MUSTN[3]	MUSTN[7]	MUSTN[7]

<sup>1</sup> This data bit corresponds to the first “pixel position.” For example, for an 8-bit mono STN display, CUSTN[0] is the leftmost pixel on the panel and CUSTN[7] is the rightmost pixel within the 8-bit data. For a color STN display, bits [7, 6, 5] form the leftmost pixel.

**Table 14: CLD[23:0] pin descriptions for STN display**

Table 15 shows which CLD[23:0] pins provide the pixel data to the TFT panel for each of the multiplexing modes of operation.

External pin	TFT 24 bit	TFT 15 bit
CLD[23]	BLUE[7]	Reserved
CLD[22]	BLUE[6]	Reserved
CLD[21]	BLUE[5]	Reserved
CLD[20]	BLUE[4]	Reserved
CLD[19]	BLUE[3]	Reserved
CLD[18]	BLUE[2]	Reserved
CLD[17]	BLUE[1]	BLUE[4]
CLD[16]	BLUE[0]	BLUE[3]

**Table 15: CLD[23:0] pin descriptions for TFT display**

External pin	TFT 24 bit	TFT 15 bit
CLD[15]	GREEN[7]	BLUE[2]
CLD[14]	GREEN[6]	BLUE[1]
CLD[13]	GREEN[5]	BLUE[0]
CLD[12]	GREEN[4]	Intensity bit
CLD[11]	GREEN[3]	GREEN[4]
CLD[10]	GREEN[2]	GREEN[3]
CLD[9]	GREEN[1]	GREEN[2]
CLD[8]	GREEN[0]	GREEN[1]
CLD[7]	RED[7]	GREEN[0]
CLD[6]	RED[6]	Intensity bit
CLD[5]	RED[5]	RED[4]
CLD[4]	RED[4]	RED[3]
CLD[3]	RED[3]	RED[2]
CLD[2]	RED[2]	RED[1]
CLD[1]	RED[1]	RED[0]
CLD[0]	RED[0]	Intensity bit

**Table 15: CLD[23:0] pin descriptions for TFT display**

This LCD TFT panel signal multiplexing table shows the RGB alignment to a 15-bit TFT with the intensity bit not used. The intensity bit, if used, should be connected to the LSB (that is, RED[0], GREEN[0], BLUE[0]) input of an 18-bit LCD TFT panel as shown in the next table.

	4	3	2	1	0	Intensity
18-bit TFT	5	4	3	2	1	0
15-bit TFT	4	3	2	1	0	x
12-bit TFT	3	2	1	0	x	x
9-bit TFT	2	1	0	x	x	x

**Table 16: RGB bit alignment according to TFT interface size (one color shown)**

If you want reduced resolution, the least significant color bits can be dropped, starting with Red[0], Green[0], and Blue[0].

**I<sup>2</sup>C interface**

Pin #	Signal name	U/D	OD (mA)	I/O	Description
AC15	iic_scl		4	I/O	I <sup>2</sup> C serial clock line. Add a 10K resistor to VDDA(3.3V) if not used.
AF16	iic_sda		4	I/O	I <sup>2</sup> C serial data line. Add a 10K resistor to VDDA(3.3V) if not used.

*Table 17: I<sup>2</sup>C interface pinout***USB Interface****Notes:**

- If not using the USB interface, these pins should be pulled down to ground through a 15K ohm resistor.
- All output drivers for USB meet the standard USB driver specification.

Pin #	Signal name	U/D	OD (mA)	I/O	Description
AB4	usb_dm			I/O	USB data -
AC3	usb_dp			I/O	USB data +

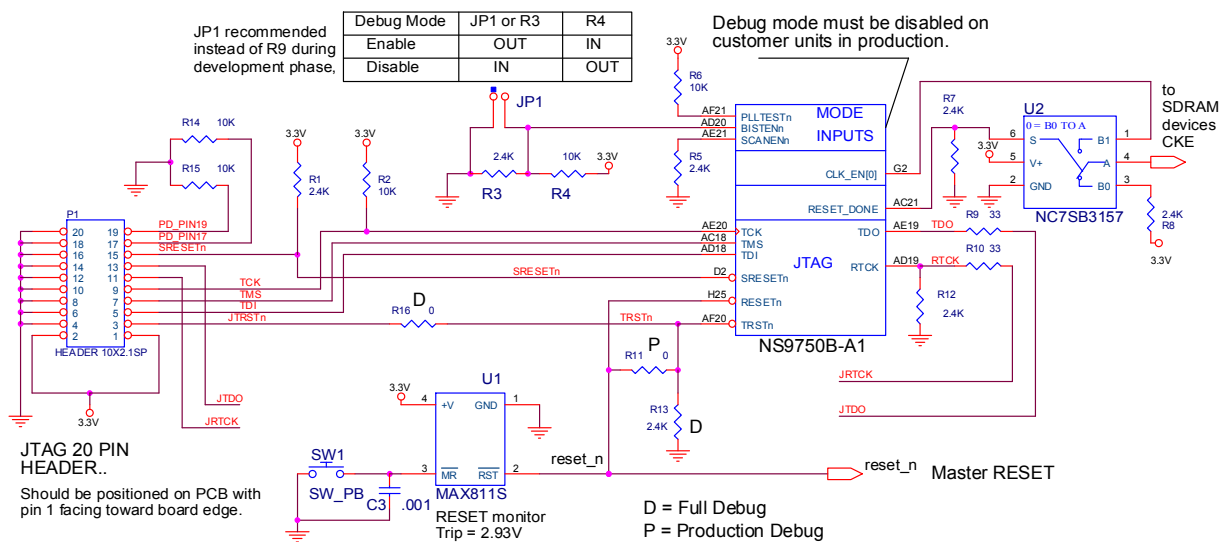
*Table 18: USB interface pinout*

### JTAG interface for ARM core/boundary scan

Note: `trst_n` must be pulsed low to initialize the JTAG when a debugger is not attached.

Pin #	Signal name	U/D	OD (mA)	I/O	Description
AE20	tck			I	Test clock
AD18	tdi	U		I	Test data in
AE19	tdo		2	O	Test data out
AC18	tms	U		I	Test mode select
AF20	trst_n	U		I	Test mode reset
AD19	rtck	U	2	I/O	Returned test clock, ARM core only

Table 19: JTAG interface/boundary scan pinout



NOTES:  
R7: Boot Method  
out - Flash/ROM/S\_CS1n  
in: - SPI\_B PROM to SDRAM/CS0n.

R12: PCI Arbiter  
out - Internal  
In - External

U2 must be duplicated for each clock enable used

If CKE on the SDRAM devices is connected to 3.3V directly or through a pull-up, U2 is not needed

Figure 7: JTAG interface

**Reserved pins**

Pin#	Description
J1	Tie to ground directly
E2	Tie to ground directly
K3	Tie to ground directly
K2	Tie to ground directly
K1	Tie to ground directly
M2	Tie to ground directly
M1	Tie to ground directly
N1	Tie to ground directly
N2	Tie to ground directly
R1	Tie to ground directly
R2	Tie to ground directly
R3	Tie to ground directly
T1	Tie to ground directly
AD4	Tie to 1.5V core power
AF2	Tie to 3.3V I/O power
AE7	No connect
L3	No connect
B7	No connect
L2	No connect
L1	No connect
M3	No connect
AF6	Tie to ground directly
AC5	Tie to ground directly
AE3	Tie to ground directly
AF22	No connect
AD21	No connect
AE22	No connect

**Table 20: Reserved pins**

## Power ground

Pin #	Signal name	Description
J23, K23, U23, V23, D17, AC17, D16, AC16, D11, D10, AC11, AC10, J4, K4, U4, V4	VDDC	Core power, 1.5V
G23, H23, P23, N23, Y23, W23, D20, AC20, D14, D13, AC14, AC13, D7, AC7, G4, H4, P4, N4, Y4, W4	VDDS	I/O power, 3.3V
A26, B25, AE25, AF26, D23, C24, AD24, AC23, D5, D4, C4, E4, AC4, A3, A2, D3, C3, C2, B3, B2, AE2, AD3, A1, C1, B1, AF1, L23, T23, D18, AC9, L4, T4, M23, R23, D19, AC19, D8, AC8, M4, R4, L11, L12, L13, L14, L15, L16, M11, M12, M13, M14, M15, M16, N11, N12, N13, N14, N15, N16, P11, P12, P13, P14, P15, P16, R11, R12, R13, R14, R15, R16, T11, T12, T13, T14, T15, T16	VSS2	Ground

**Table 21: Power ground pins**

## Address and register maps

### System address map

The system memory address is divided to allow access to the internal and external resources on the system bus, as shown in Table 22.

Address range	Size	System functions
0x0000 0000 – 0x0FFF FFFF	256 MB	System memory chip select 4 - Dynamic memory (default)
0x1000 0000 – 0x1FFF FFFF	256 MB	System memory chip select 5 - Dynamic memory (default)
0x2000 0000 – 0x2FFF FFFF	256 MB	System memory chip select 6 - Dynamic memory (default)
0x3000 0000 – 0x3FFF FFFF	256 MB	System memory chip select 7 - Dynamic memory (default)
0x4000 0000 – 0x4FFF FFFF	256 MB	System memory chip select 0 - Static memory (default)
0x5000 0000 – 0x5FFF FFFF	256 MB	System memory chip select 1 - Static memory (default)
0x6000 0000 – 0x6FFF FFFF	256MB	System memory chip select 2 - Static memory (default)
0x7000 0000 – 0x7FFF FFFF	256 MB	System memory chip select 3 - Static memory (default)
0x8000 0000 – 0x8FFF FFFF	256 MB	PCI memory
0x9000 0000 – 0x9FFF FFFF	256 MB	BBus peripherals
0xA000 0000 – 0xA00F FFFF	1 MB	PCI IO
0xA010 0000 – 0xA01F FFFF	1 MB	PCI CONFIG_ADDR
0xA020 0000 – 0xA02F FFFF	1 MB	PCI CONFIG_DATA
0xA030 0000 – 0xA03F FFFF	1 MB	PCI arbiter

**Table 22: System address memory map**

Address range	Size	System functions
0xA040 0000 – 0xA04F FFFF	1 MB	BBus-to-AHB bridge
0xA050 0000 – 0xA05F FFFF	1 MB	Reserved
0xA060 0000 – 0xA06F FFFF	1 MB	Ethernet Communication module
0xA070 0000 – 0xA07F FFFF	1 MB	Memory controller
0xA080 0000 – 0xA08F FFFF	1 MB	LCD controller
0xA090 0000 – 0xA09F FFFF	1 MB	System Control module
0xA0A0 0000 – 0xFFFF FFFF	1526 MB	Reserved

**Table 22: System address memory map**

### BBus peripheral address map

The BBus bridge configuration registers are located at base address 0xA040 0000. The BBus peripherals are located at base address 0x9000 0000 and span a 256 MB address space. Each BBus peripheral, with the exception of the SER controllers, resides in a 1 MB address space. Table 23 specifies the address space given to each peripheral.

Base address	Peripheral
0x9000 0000	BBus DMA controller
0x9010 0000	USB controller
0x9020 0000	SER Port B
0x9020 0040	SER Port A
0x9030 0000	SER Port C
0x9030 0040	SER Port D
0x9040 0000	IEEE 1284 controller
0x9050 0000	I <sup>2</sup> C controller
0x9060 0000	BBus utility

**Table 23: BBus peripheral address map**

## Electrical characteristics

The NS9750B-A1 operates at a 1.5V core, with 3.3V I/O ring voltages.

### Absolute maximum ratings

Permanent device damage can occur if the absolute maximum ratings are exceeded even for an instant.

Parameter	Symbol†	Rating	Unit
DC supply voltage	$V_{DDA}$	-0.3 to +3.9	V
DC input voltage	$V_{INA}$	-0.3 to $V_{DDA}+0.3$	V
DC output voltage	$V_{OUTA}$	-0.3 to $V_{DDA}+0.3$	V
DC input current	$I_{IN}$	±10	mA
Storage temperature	$T_{STG}$	-40 to +125	°C

†  $V_{DDA}$ ,  $V_{INA}$ ,  $V_{OUTA}$ : Ratings of I/O cells for 3.3V interface

### Recommended operating conditions

Recommended operating conditions specify voltage and temperature ranges over which a circuit's correct logic function is guaranteed. The specified DC electrical characteristics (see "DC electrical characteristics" on page 43) are satisfied over these ranges.

Parameter	Symbol†	Rating	Unit
DC supply voltage	$V_{DDA}$	3.0 to 3.6	V
	$V_{DDC}$ (core)	1.4 to 1.6	V
	$V_{DDC}$ (PLL)	1.425 to 1.575	V
Maximum junction temperature	$T_J$	125	°C

†  $V_{DDA}$ : Ratings of I/O cells for 3.3V interface  
 $V_{DDC}$ : Ratings of internal cells

## Maximum power dissipation

Table 24 shows the maximum power dissipation, including sleep mode information, for I/O and core:

CPU clock	Operation			Sleep mode with wake up on			
	Full	No PCI	No PCI, LCD	All ports	BBus ports	AHB bus ports	No wake up ports
Total @ 200 MHz	1.7 W	1.55 W	1.5 W	350 mW	285 mW	240 mW	180 mW
Core	1.05 W	1 W	1 W	260mW	210 mW	220 mW	170 mW
I/O	0.65 W	0.55 W	0.5 W	90 mW	75 mW	20 mW	10 mW
Total @ 162 MHz	1.4 W	1.25 W	1.2 W	285 mW	235 mW	200 mW	145 mW
Core	0.9 W	0.8 W	0.8 W	210 mW	170 mW	180 mW	140 mW
I/O	0.5 W	0.45 W	0.4 W	75 mW	65 mW	20 mW	5 mW
Total @ 125 MHz	1.05 W	1 W	950 mW	220 mW	180 mW	150 mW	110 mW
Core	0.65 W	0.65 W	640 mW	210 mW	130 mW	140 mW	105 mW
I/O	0.4 W	0.35 W	310 mW	75 mW	50 mW	10 mW	5 mW

**Table 24: NS9750B-A1 maximum power dissipation**

## Typical power dissipation

Figure 25 shows typical power dissipation for I/O and core:

CPU clock	Operation		
	Full	No PCI	No PCI, LCD
Total @ 200 MHz	952 mW	886 mW	809 mW
Core	419 mW	353 mW	287 mW
I/O	533 mW	533 mW	522 mW
Total @ 162 MHz	784 mW	715 mW	647 mW
Core	345mW	285 mW	230 mW
I/O	439mW	430mW	418 mW
Total @ 125 MHz	588 mW	572 mW	512 mW
Core	259 mW	228 mW	182 mW
I/O	329 mW	344 mW	331 mW

**Table 25: NS9750B-A1 typical power dissipation**

## DC electrical characteristics

DC electrical characteristics specify the worst-case DC electrical performance of the I/O buffers that are guaranteed over the specified temperature range.

### Inputs

All electrical inputs are 3.3V interface.

**Note:**  $V_{SS} = 0V$  (GND)

Sym	Parameter	Condition	Value	Unit	
$V_{IH}$	High-level input voltage:		Min		
	LVTTL level		2.0	V	
	PCI level		$0.5V_{DDA}$	V	
$V_{IL}$	Low-level input voltage:		Max		
	LVTTL level		0.8	V	
	PCI level		$0.3V_{DDA}$	V	
$I_{IH}$	High-level input current (no pulldown)	$V_{INA}=V_{DDA}$	Min/Max	-10/10	$\mu A$
	Input buffer with pulldown		Min/Max <sup>1</sup>	10/200	$\mu A$
$I_{IL}$	Low-level input current (no pullup)	$V_{INA}=V_{SS}$	Min/Max	-10/10	$\mu A$
	Input buffer with pullup		Min/Max <sup>2</sup>	10/200	$\mu A$
$I_{OZ}$	High-impedance leakage current	$V_{OUTA}=V_{DDA}$ or $V_{SS}$	Min/Max	-10/10	$\mu A$
$I_{DDs}$	Quiescent supply current	$V_{INA}=V_{DDA}$ or $V_{SS}$	Max	TBD	

1. Min current =  $V_{IN-}$  or  $V_{IN}$  at 0.0V.

2. Min current =  $V_{IN-}$  or  $V_{IN}$  at 0.0V.

### USB DC electrical inputs

Symbol	Parameter	Min	Max	Units	Notes
$V_{IH}$	Input high level (driven)	2.0	$V_{DDA}-0.6$	V	
$V_{IZ}$	Input high level (floating)	2.7	3.6	V	
$V_{IL}$	Input low level		0.8	V	
$V_{DI}$	Differential input sensitivity	0.2		V	1
$V_{CM}$	Differential common mode range	0.8	2.5	V	2

#### Notes:

1  $|(\text{usb\_dp}) - (\text{usb\_dm})|$

2 Includes  $V_{DI}$  range.

## Outputs

All electrical outputs are 3.3V interface.

Sym	Parameter	Value	Unit	
V <sub>OH</sub>	High-level output voltage (LVTTL)	Min	V <sub>DDA</sub> -0.6	V
V <sub>OL</sub>	Low-level output voltage (LVTTL)	Max	0.4	V
V <sub>OH</sub>	PCI high-level output voltage	Min	0.9V <sub>DDA</sub>	V
V <sub>OL</sub>	PCI low-level output voltage	Max	0.1V <sub>DDA</sub>	V

### USB DC electrical outputs

Symbol	Parameter	Min	Max	Units	Notes
V <sub>OL</sub>	Output low level	0.0	0.3	V	1
V <sub>OH</sub>	Output high level	2.8	3.6	V	2
V <sub>CRS</sub>	Output signal crossover voltage	1.3	2.0	V	3

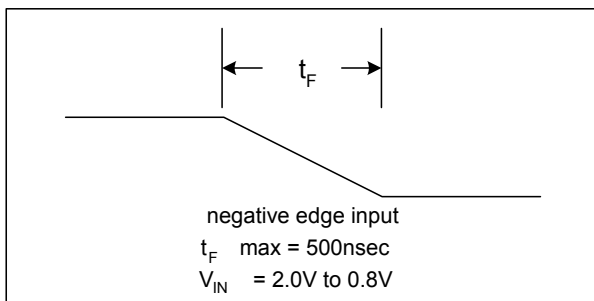
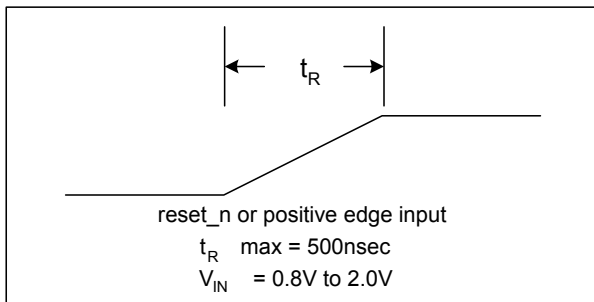
#### Notes:

- 1 Measured with R<sub>L</sub> of 1.425k ohm to 3.6V.
- 2 Measured with R<sub>L</sub> of 14.25k ohm to GND.
- 3 Excluding the first transition from the idle state.

## Reset and edge sensitive input timing requirements

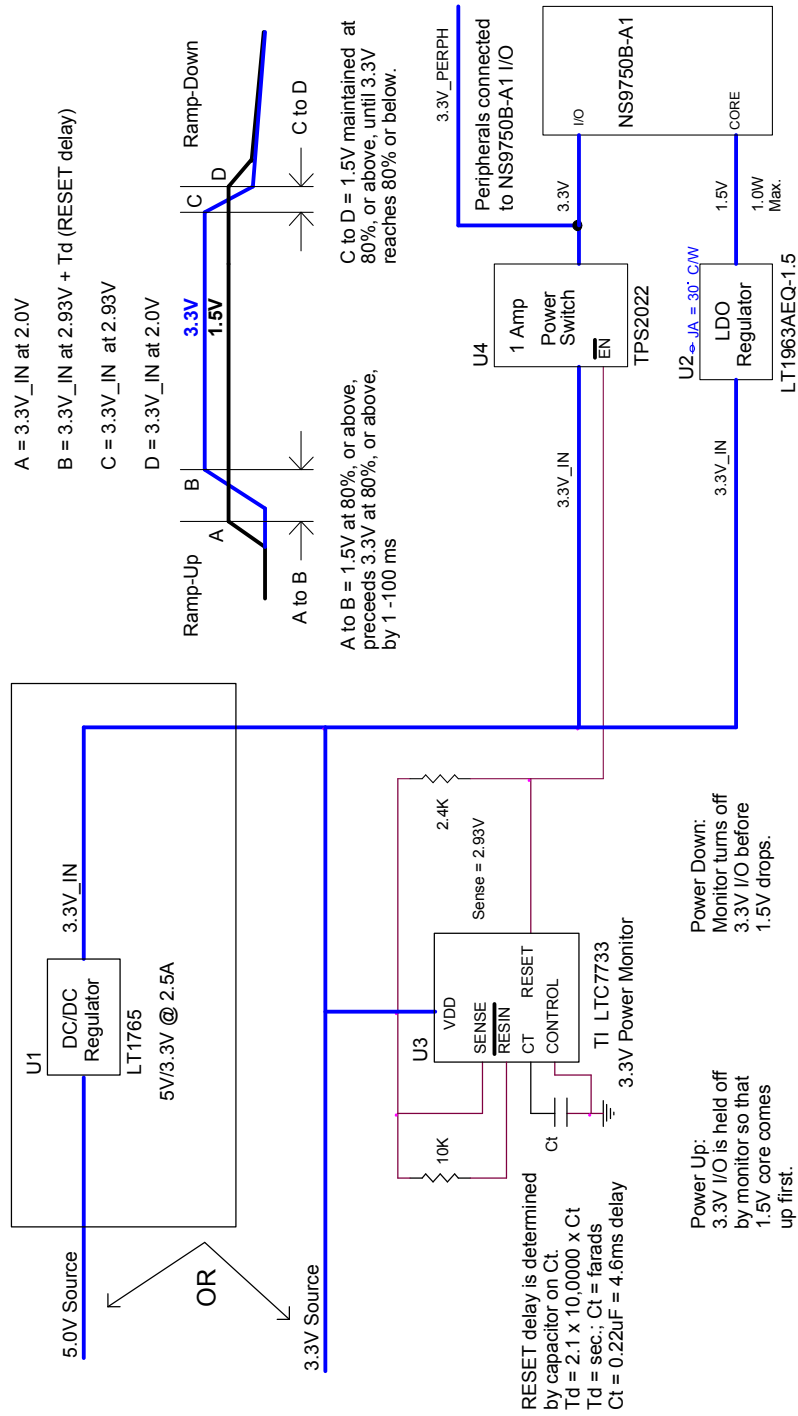
The critical timing requirement is the rise and fall time of the input. If the rise time is too slow for the reset input, the hardware strapping options may be registered incorrectly. If the rise time of a positive-edge-triggered external interrupt is too slow, then an interrupt may be detected on both the rising and falling edge of the input signal.

A maximum rise and fall time must be met to ensure that reset and edge sensitive inputs are handled correctly. With Digi processors, the maximum is 500 nanoseconds as shown:



## Power sequencing

Use these requirements for power sequencing.



NS9750B-A1 Power Sequencing Block Diagram - 5V or 3V source

## Memory timing

Memory AC characteristics are measured with 35pF, unless otherwise noted.

Memory timing contains parameters and diagrams for both SDRAM and SRAM timing.

### SDRAM timing

Table 26 describes the values shown in the SDRAM timing diagrams.

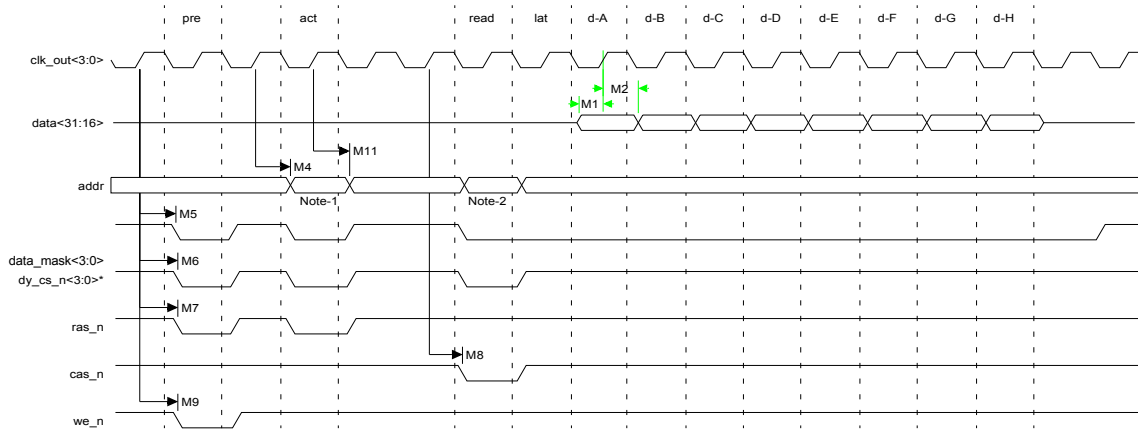
Parameter	Description	Min	Max	Unit	Notes
M1	data input setup time to rising	1.6		ns	
M2	data input hold time to rising	1.5		ns	
M3	clk_out high to clk_en high		6.1	ns	
M4	clk_out high to address valid		6.1	ns	
M5	clk_out high to data_mask		6.1	ns	1, 2
M6	clk_out high to dy_cs_n low		6.1	ns	3, 4
M7	clk_out high to ras_n low		6.1	ns	
M8	clk_out high to cas_n low		6.1	ns	
M9	clk_out high to we_n low		6.1	ns	
M10	clk_out high to data out		6.2	ns	
M11	address hold time	3.5			
M12	data out hold time	3.8			
M13	clk_en high to sdram access	2	2	clock	
M14	end sdram access to clk_en low	2	2	clock	

**Table 26: SDRAM timing parameters**

#### Notes:

- 1 All four data\_mask signals are used for all transfers.
- 2 All four data\_mask signals will go low during a read cycle, for both 16-bit and 32-bit transfers.
- 3 Only one of the four clk\_out signals is used.
- 4 Only one of the four dy\_cs\_n signals is used.

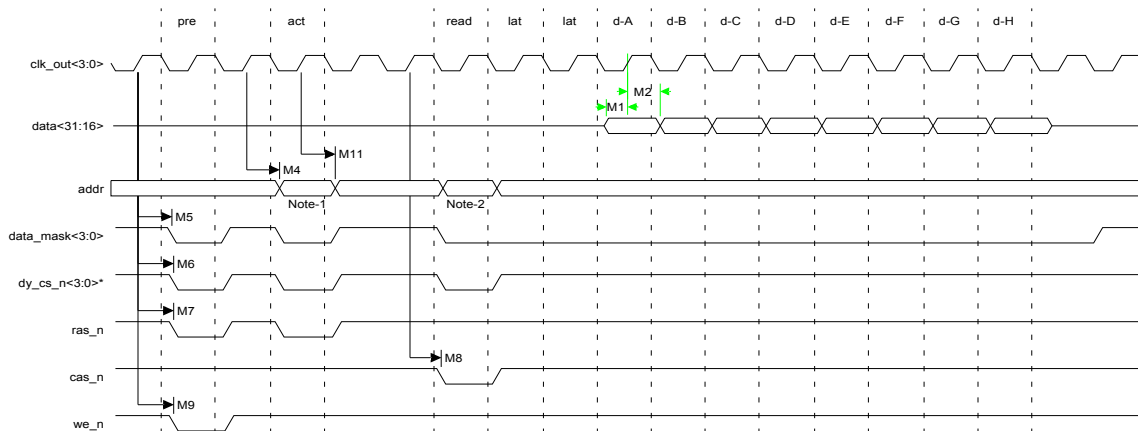
**SDRAM burst read (16-bit)**



**Notes:**

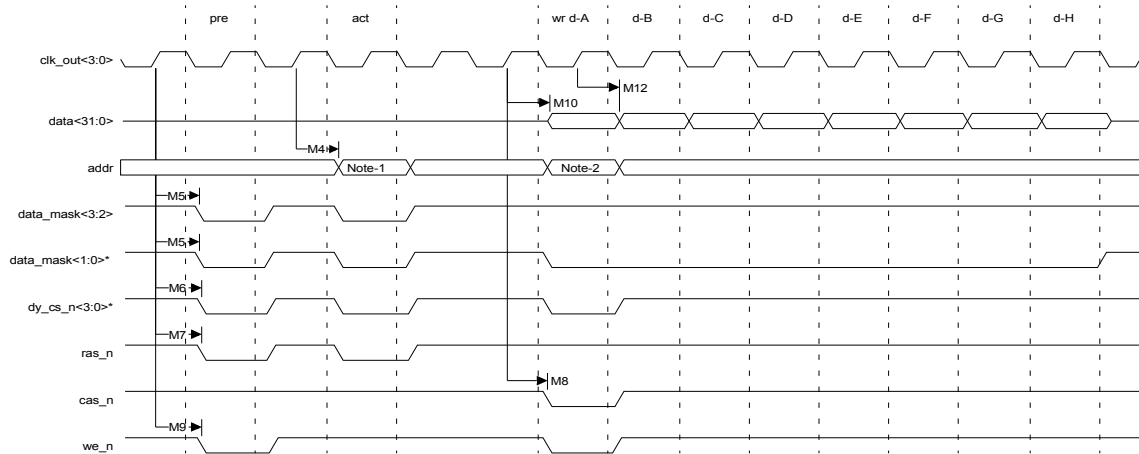
- 1 This is the bank and RAS address.
- 2 This is the CAS address

**SDRAM burst read (16-bit), CAS latency = 3**

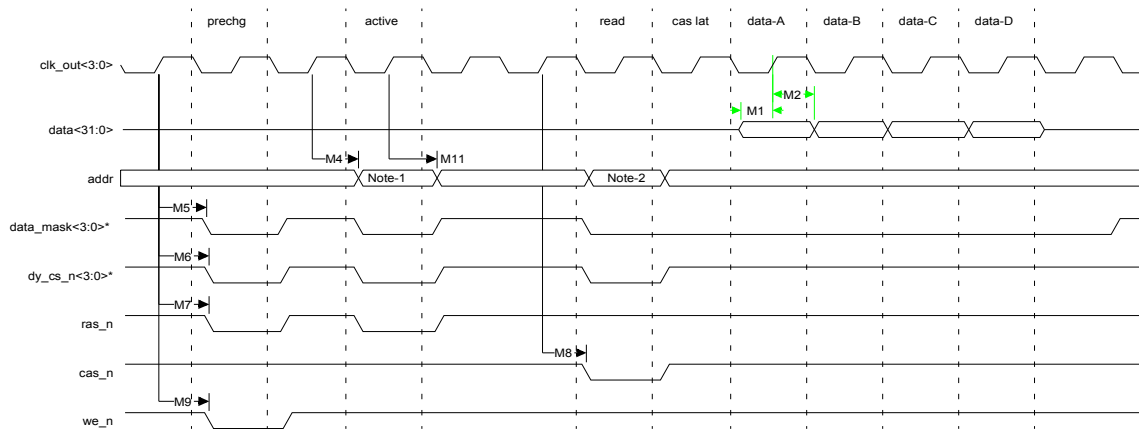


**Notes:**

- 1 This is the bank and RAS address.
- 2 This is the CAS address

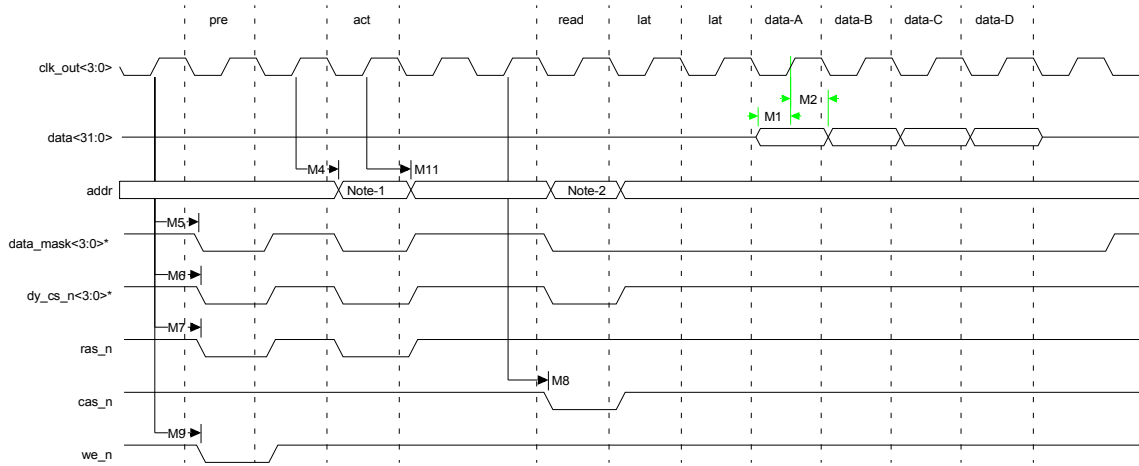
**SDRAM burst write (16-bit)****Notes:**

- 1 This is the bank and RAS address.
- 2 This is the CAS address

**SDRAM burst read (32-bit)****Notes:**

- 1 This is the bank and RAS address.
- 2 This is the CAS address

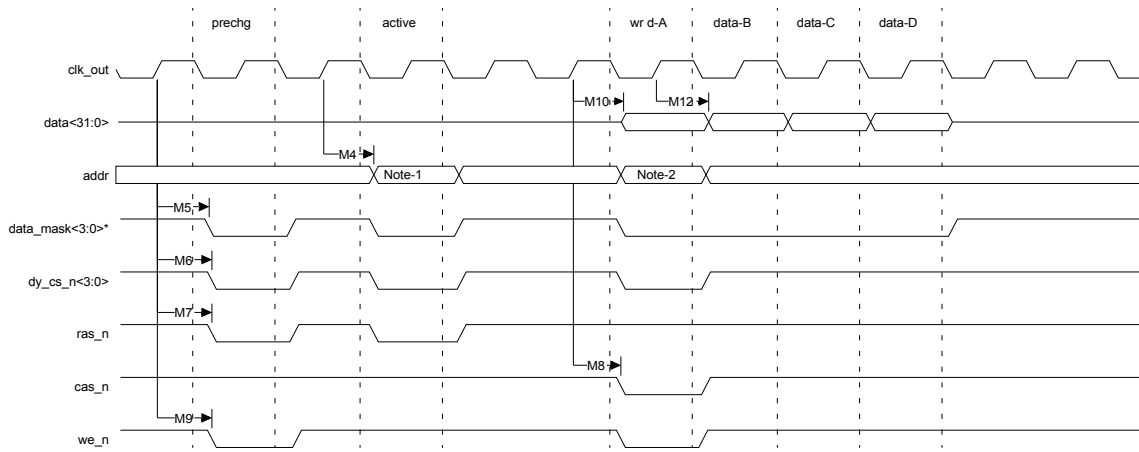
**SDRAM burst read (32-bit), CAS latency = 3**



**Notes:**

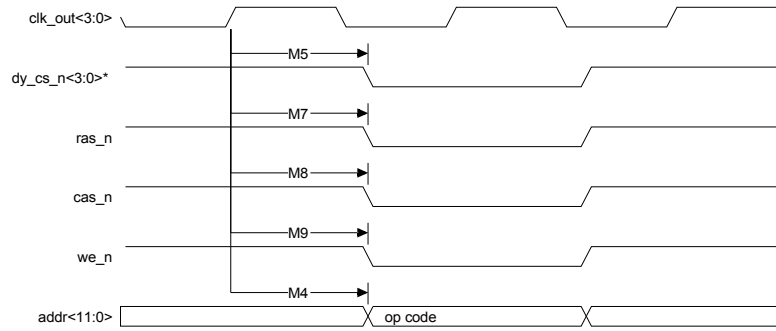
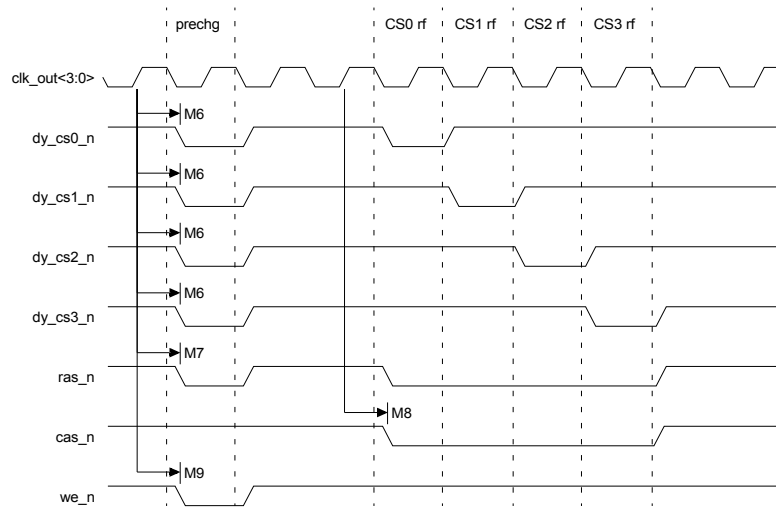
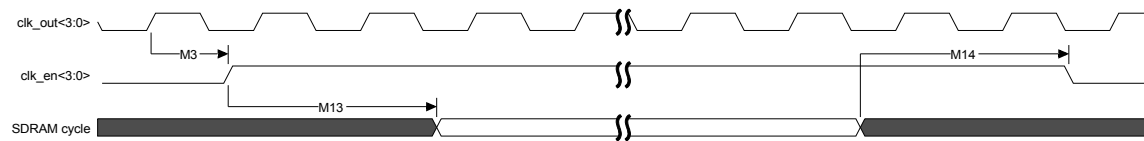
- 1 This is the bank and RAS address.
- 2 This is the CAS address.

**SDRAM burst write (32-bit)**



**Notes:**

- 1 This is the bank and RAS address.
- 2 This is the CAS address.

**SDRAM load mode****SDRAM refresh mode****Clock enable timing**

## SRAM timing

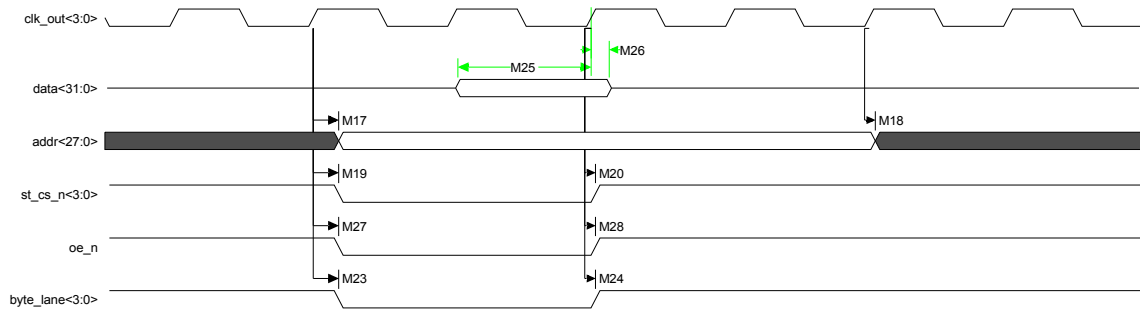
Table 27 describes the values shown in the SRAM timing diagrams.

Parameter	Description	Min	Max	Unit	Notes
M15	clock high to data out valid		+2	ns	
M16	data out hold time from clock high	-2		ns	
M17	clock high to address valid		+2	ns	
M18	address hold time from clock high	-2		ns	
M19	clock high to st_cs_n low		+2	ns	1
M20	clock high to st_cs_n high		+2	ns	1
M21	clock high to we_n low		+2	ns	
M22	clock high to we_n high		+2	ns	
M23	clock high to byte_lanes low		+2	ns	
M24	clock high to byte_lanes high		+2	ns	
M25	data input setup time to rising clk		4.5	ns	
M26	data input hold time to rising clk	4.5		ns	
M27	clock high to oe_n low		+2	ns	
M28	clock high to oe_n high		+2	ns	

**Table 27: SRAM timing parameters**

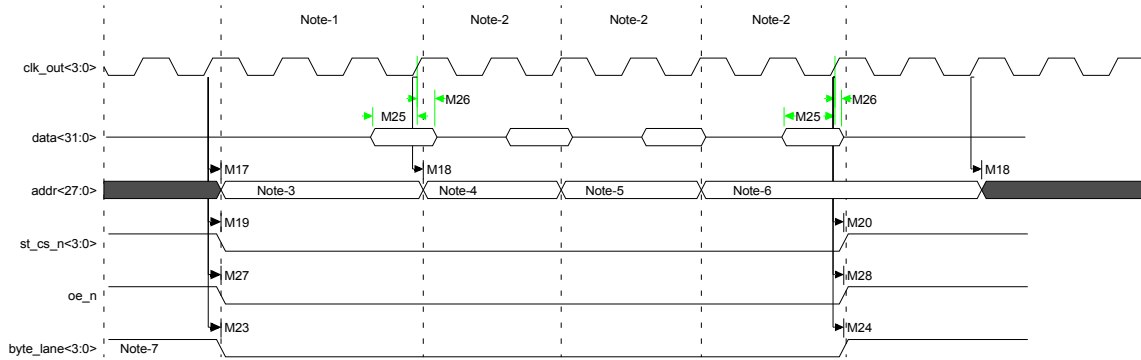
### Notes:

- Only one of the four dy\_cs\_n signals is used. The diagrams show the active low configuration, which can be reversed (active high) with the PC field. Use this formula to calculate the length of the st\_cs\_n signal:  
 $T_{acc} + \text{board delay} + (\text{optional buffer delays, both address out and data in}) + 10\text{ns}$

**Static RAM read cycles with 1 wait state**

- **WTRD = 1**  
**WOEN = 0**
- If the PB field is set to 1, all four `byte_lane` signals will go low for 32-bit, 16-bit, and 8-bit read cycles.
- If the PB field is set to 0, the `byte_lane` signal will always be high.

**Static RAM asynchronous page mode read, WTPG = 1**

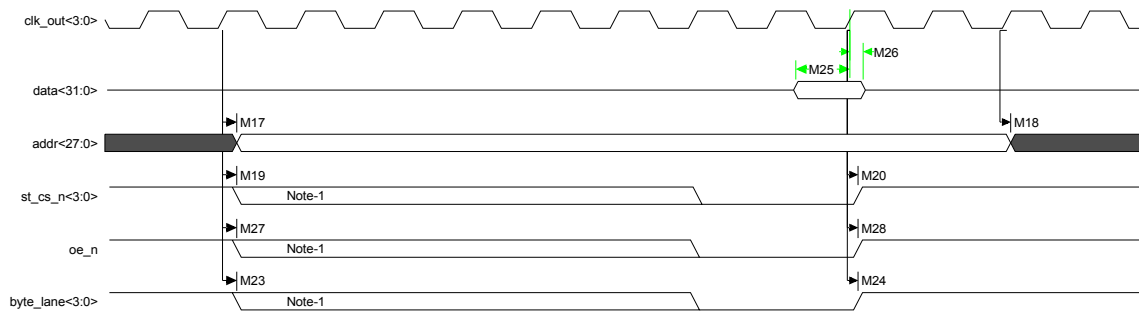


- WTPG = 1  
WTRD = 2
- If the PB field is set to 1, all four `byte_lane` signals will go low for 32-bit, 16-bit, and 8-bit read cycles.
- The asynchronous page mode will read 16 bytes in a page cycle. A 32-bit bus will do four 32-bit reads, as shown (3-2-2-2). A 16-bit bus will do eight 16-bit reads (3-2-2-2-3-2-2-2) per page cycle, and an 8-bit bus will do sixteen reads (3-2-2-2-3-2-2-2-3-2-2-2-3-2-2-2) per page cycle. 3-2-2-2 is the example used here, but the WTRD and WTPG field can set them differently.

**Notes:**

- 1 The length of the first cycle in the page is determined by the WTRD field.
- 2 The length of the 2nd, 3rd, and 4th cycles is determined by the WTPG field.
- 3 This is the starting address. The least significant two bits will always be '00.'
- 4 The least significant two bits in the second cycle will always be '01.'
- 5 The least significant two bits in the third cycle will always be '10.'
- 6 The least significant two bits in the fourth cycle will always be '11.'
- 7 If the PB field is set to 0, the `byte_lane` signal will always be high during a read cycle.

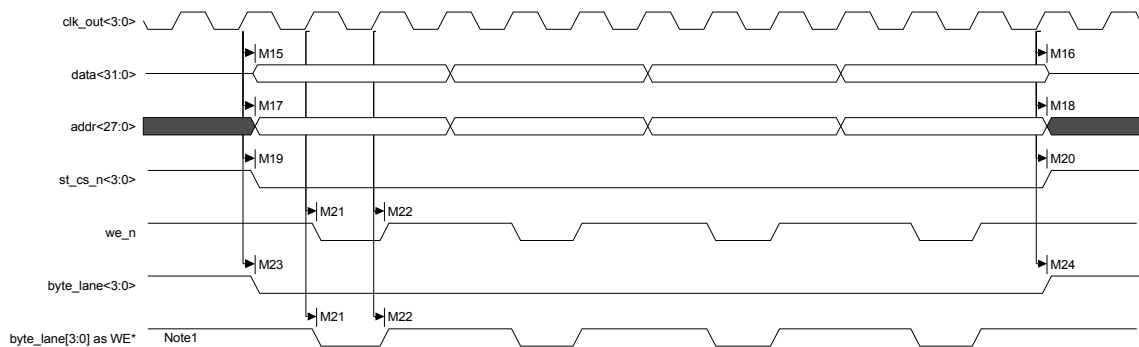
### Static RAM read cycle configurable wait states



- WTRD = from 1 to 15  
WOEN = from 0 to 15
- If the PB field is set to 1, all four byte\_lane signals will go low for 32-bit, 16-bit, and 8-bit read cycles.
- If the PB field is set to 0, the byte\_lane signal will always be high.
- The length of the read cycle is determined by the WTRD field.

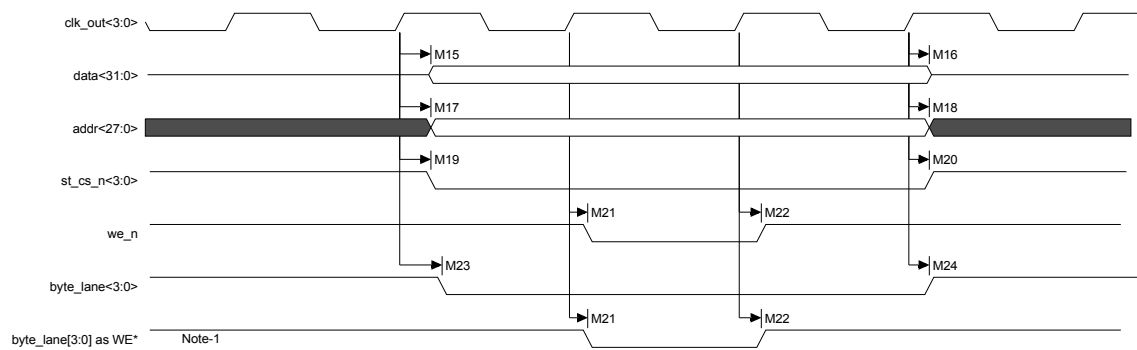
**Note:** The length of the st\_cs\_n, oe\_n, and the byte\_lane signals are determined by a combination of the WTRD and the WOEN fields.

### Static RAM sequential write cycles



- WTWR = 0  
WWEN = 0
- During a 32-bit transfer, all four byte\_lane signals will go low.
- During a 16-bit transfer, two byte\_lane signals will go low.
- During an 8-bit transfer, only one byte\_lane signal will go low.

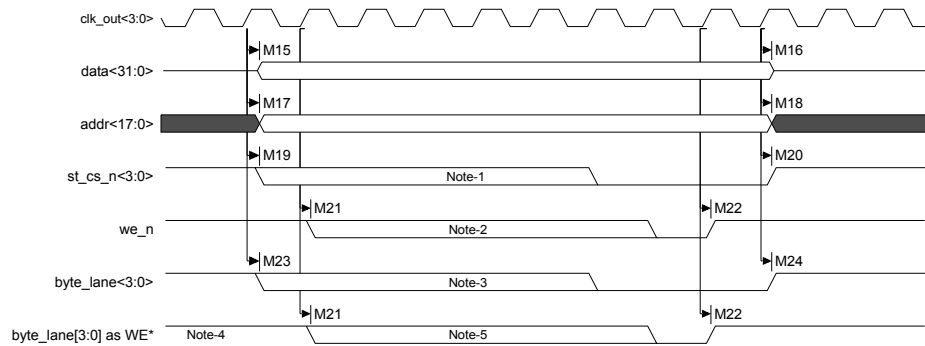
**Note:** If the PB field is set to 0, the byte\_lane signals will function as write enable signals and the we\_n signal will always be high.

**Static RAM write cycle**

- `WTWR = 0`  
`WWEN = 0`
- During a 32-bit transfer, all four `byte_lane` signals will go low.
- During a 16-bit transfer, two `byte_lane` signals will go low.
- During an 8-bit transfer, only one `byte_lane` signal will go low.

**Note:** If the PB field is set to 0, the `byte_lane` signals will function as write enable signals and the `we_n` signal will always be high.

### Static write cycle with configurable wait states



- WTWR = from 0 to 15  
WWEN = from 0 to 15
- The WTWR field determines the length on the write cycle.
- During a 32-bit transfer, all four `byte_lane` signals will go low.
- During a 16-bit transfer, two `byte_lane` signals will go low.
- During an 8-bit transfer, only one `byte_lane` signal will go low.

#### Notes:

- 1 Timing of the `st_cs_n` signal is determined with a combination of the WTWR and WWEN fields. The `st_cs_n` signal will always go low at least one clock before `we_n` goes low, and will go high one clock after `we_n` goes high.
- 2 Timing of the `we_n` signal is determined with a combination of the WTWR and WWEN fields.
- 3 Timing of the `byte_lane` signals is determined with a combination of the WTWR and WWEN fields. The `byte_lane` signals will always go low one clock before `we_n` goes low, and will go one clock high after `we_n` goes high.
- 4 If the PB field is set to 0, the `byte_lane` signals will function as the write enable signals and the `we_n` signal will always be high.
- 5 If the PB field is set to 0, the timing for the `byte_lane` signals is set with the WTWR and WWEN fields.

**Slow peripheral acknowledge timing**

Table 28 describes the values shown in the slow peripheral acknowledge timing diagrams.

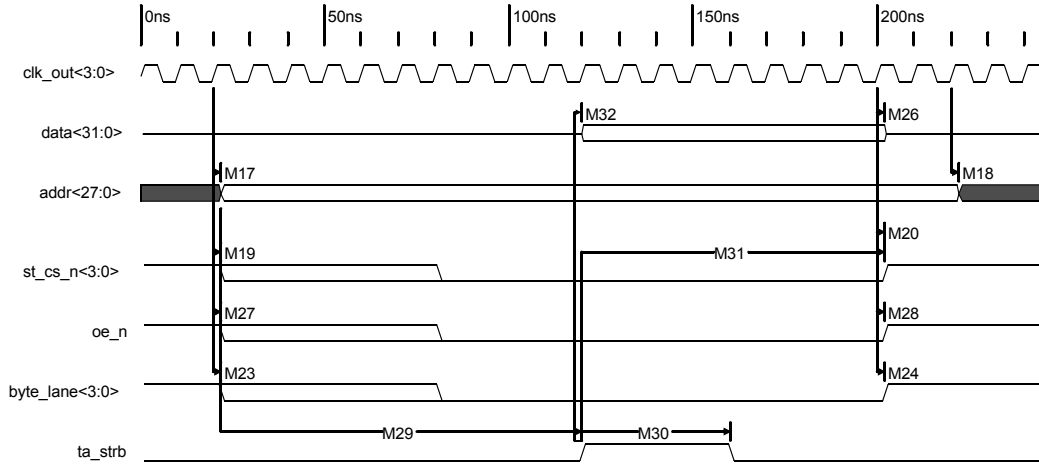
Parameter	Description	Min	Max	Unit	Notes
M15	clock high to data out valid		+2	ns	
M16	data out hold time from clock high	-2		ns	
M17	clock high to address valid		+2	ns	
M18	address hold time from clock high	-2		ns	
M19	clock high to st_cs_n low		+2	ns	1
M20	clock high to st_cs_n high		+2	ns	1
M21	clock high to we_n low		+2	ns	
M22	clock high to we_n high		+2	ns	
M23	clock high to byte_lanes low		+2	ns	
M24	clock high to byte_lanes high		+2	ns	
M26	data input hold time to rising clk	4.5		ns	
M27	clock high to oe_n low		+2	ns	
M28	clock high to oe_n high		+2	ns	
M29	address/chip select valid to ta_strb high	2		CPU cycles	
M30	ta_strb pulse width	4	8	CPU cycles	
M31	ta_strb rising to chip select/address change	4	10	CPU cycles	
M32	data setup to ta_strb rising	0		ns	

**Table 28: Slow peripheral acknowledge**

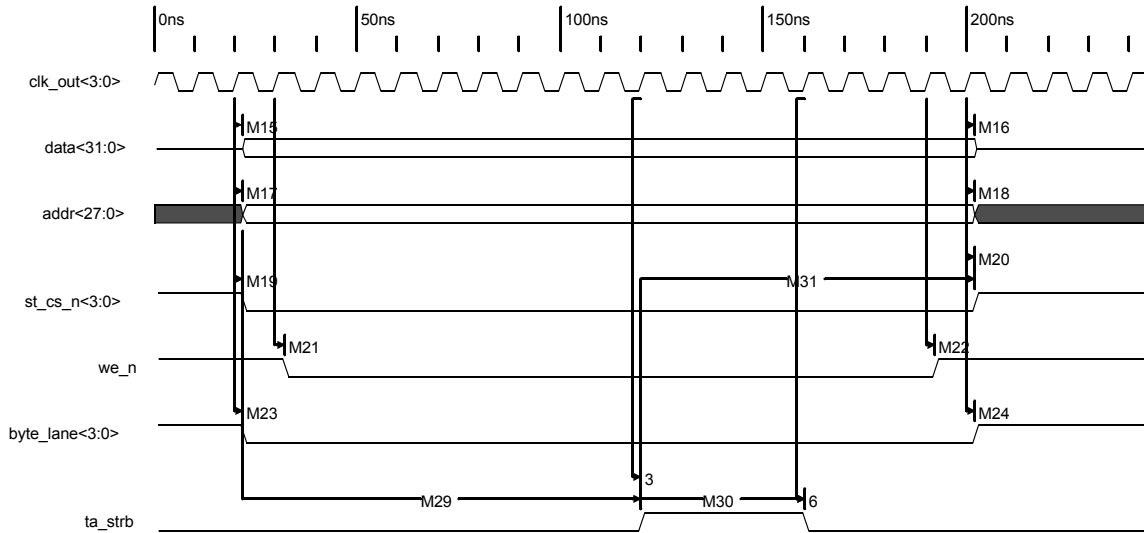
**Note:**

- 1 Only one of the four st\_cs\_n signals is used. The diagrams show the active low configuration, which can be reversed (active high) with the PC field.

*Slow peripheral acknowledge read*



*Slow peripheral acknowledge write*



## Ethernet timing

Ethernet AC characteristics are measured with 10pF, unless otherwise noted.

Table 29 describes the values shown in the Ethernet timing diagrams.

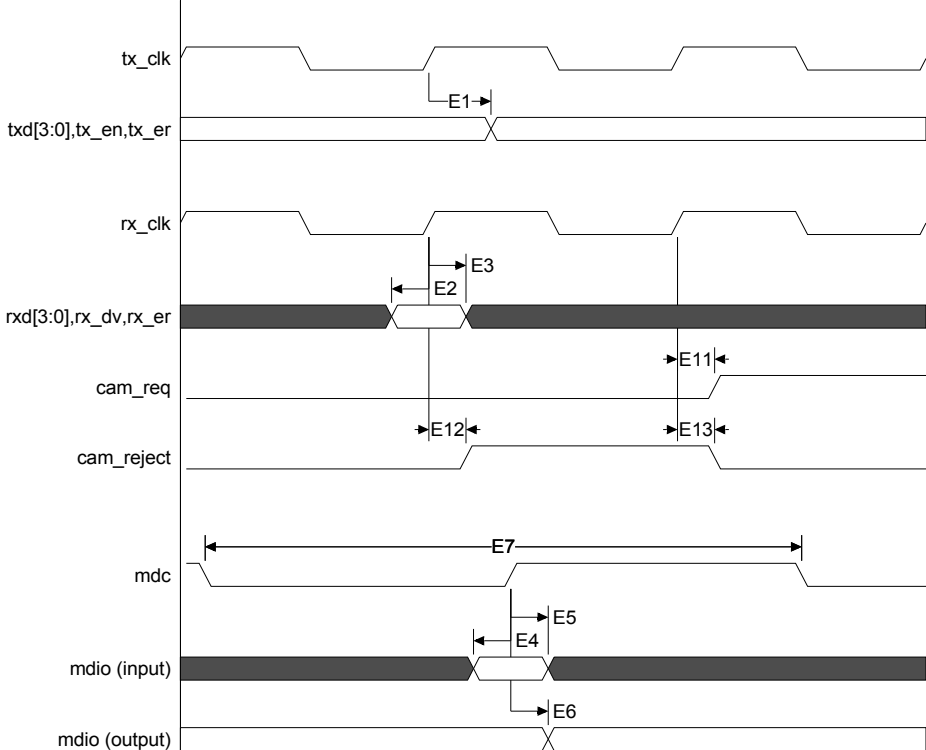
Parameter	Description	Min	Max	Unit	Notes
E1	MII tx_clk to txd, tx_en, tx_er	3	11	ns	2
E2	MII rxd, rx_dv, rx_er setup to rx_clk rising	3		ns	
E3	MII rxd, rx_dv, rx_er hold from rx_clk rising	1		ns	
E4	mdio (input) setup to mdc rising	10		ns	
E5	mdio (input) hold from mdc rising	0		ns	
E6	mdc to mdio (output)	18	38	ns	1, 2
E7	mdc period	80		ns	
E8	RMII ref_clk to txd, tx_en	3	12	ns	2
E9	RMII rxd, crs, rx_er setup to ref_clk rising	3		ns	
E10	RMII rxd, crs, rx_er hold from ref_clk rising	1		ns	
E11	MII rx_clk to cam_req	3	10	ns	
E12	MII cam_reject setup to rx_clk rising	N/A		ns	3
E13	MII cam_reject hold from rx_clk rising	N/A		ns	3

**Table 29: Ethernet timing characteristics**

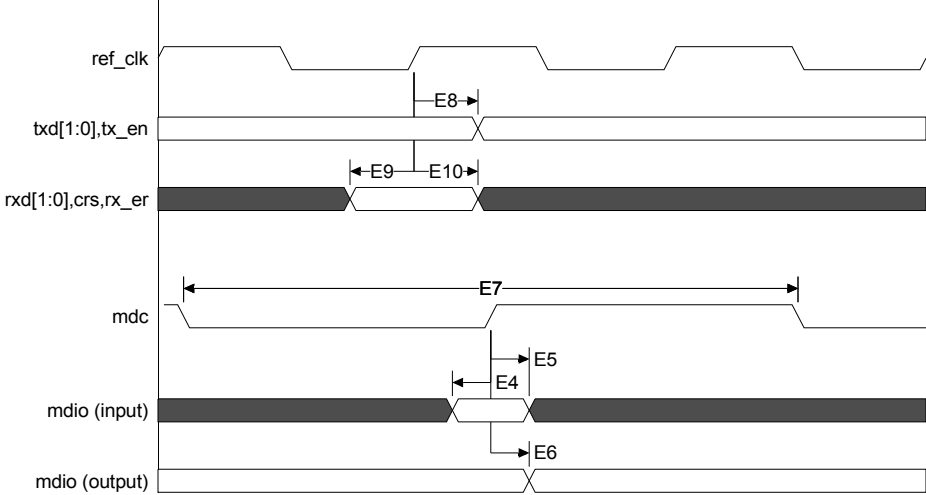
### Notes:

- 1 Minimum specification is for fastest AHB bus clock of 100 MHz. Maximum specification is for slowest AHB bus clock of 50 MHz.
- 2  $C_{load} = 10\text{pF}$  for all outputs and bidirects.
- 3 No setup and hold requirements for cam\_reject because it is an asynchronous input. This is also true for RMII PHY applications.

**Ethernet MII timing**



**Ethernet RMII timing**



## PCI timing

PCI AC characteristics are measured with 10pF, unless otherwise noted.

Table 30 and Table 31 describe the values shown in the PCI timing diagrams.

Parameter	Description	Min	Max	Units	Notes
P1	pci_clk_in to signal valid delay	2	9	ns	1, 2
P2	input setup to pci_clk_in	5		ns	1
P3	input hold from pci_clk_in	0		ns	
P4	pci_clk_in to signal active	2		ns	2
P5	pci_clk_in to signal float		28	ns	2
P6	pci_clk_out high time	50%-1	50%+1	ns	3
P7	pci_clk_out low time	50%-1	50%+1	ns	3
P8	pci_clk_in cycle time	30		ns	
P9	pci_clk_in high time	11		ns	
P10	pci_clk_in low time	11		ns	

**Table 30: PCI timing characteristics**

### Notes:

- Parameters same for bussed and point-to-point signals.
- $C_{LOAD} = 10\text{pf}$  on all outputs
- pci\_clk\_out high and low times specified as 50% of the clock period  $\pm 1$  ns.

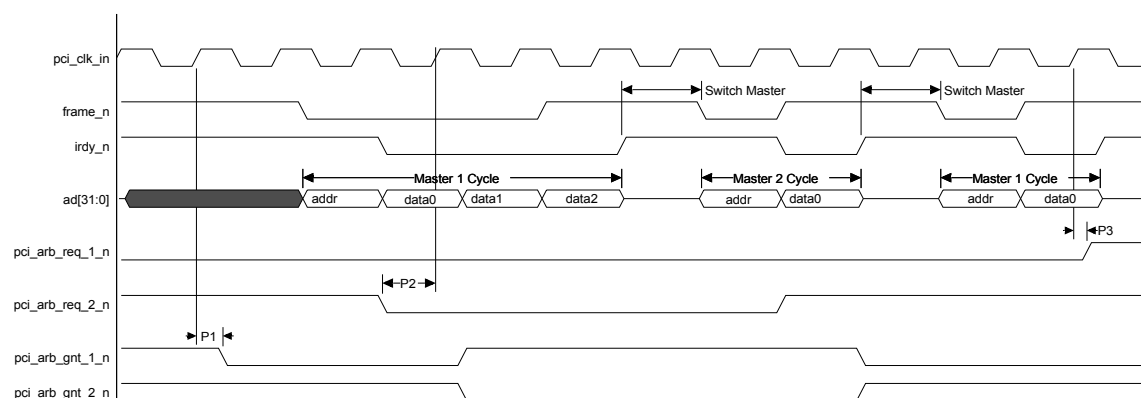
Parameter	Description	Min	Max	Units	Notes
P1	pci_clk_in to signal valid delay	2	10	ns	1
P2	input setup to pci_clk_in	5		ns	1
P3	input hold from pci_clk_in	0		ns	
P4	pci_clk_in to signal active	2		ns	1
P5	pci_clk_in to signal float		28	ns	1
P6	pci_clk_out high time	50%-1	50%+1	ns	2
P7	pci_clk_out low time	50%-1	50%+1	ns	2
P8	pci_clk_in cycle time	30		ns	
P9	pci_clk_in high time	11		ns	
P10	pci_clk_in low time	11		ns	

**Table 31: CardBus timing characteristics**

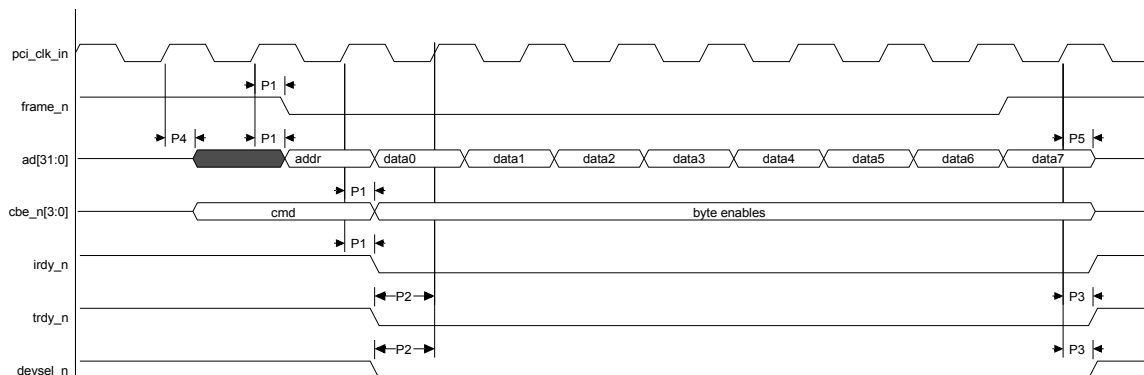
**Notes:**

- 1 Minimum times are specified with 0pf and maximum times are specified with 30pf.
- 2 pci\_clk\_out high and low times specified as 50% of the clock period  $\pm$  1 ns.

**Internal PCI arbiter timing**



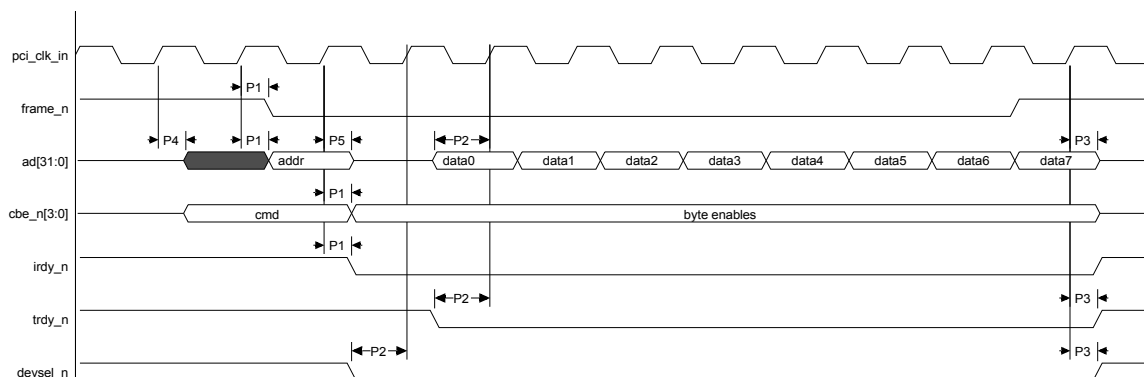
**PCI burst write from NS9750B-A1 timing**



**Note:**

The functional timing for trdy\_n and devsel\_n shows the fastest possible response from the target.

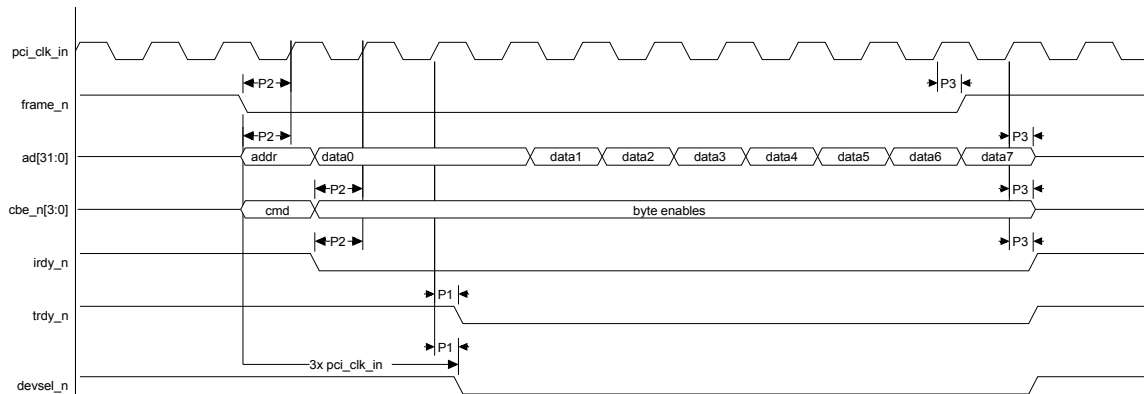
**PCI burst read from NS9750B-A1 timing**



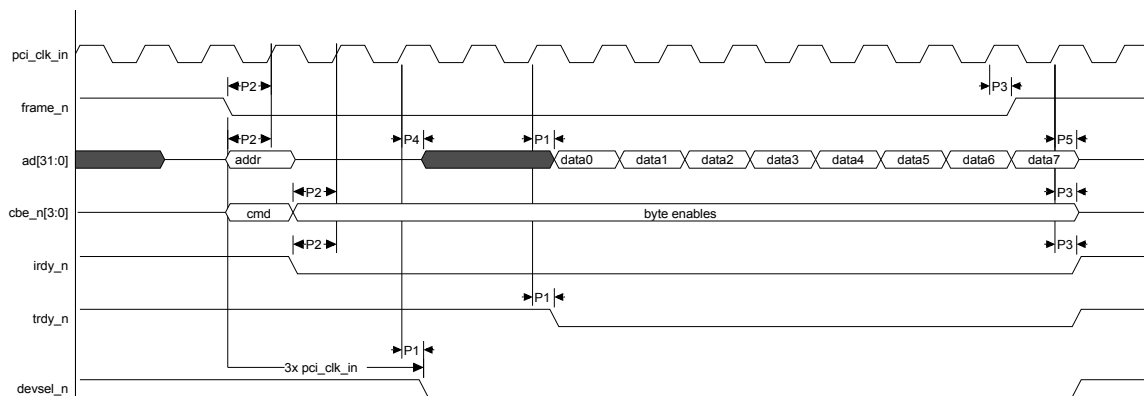
**Note:**

The functional timing for trdy\_n, devsel\_n, and the read data on ad[31:0] shows the fastest possible response from the target.

**PCI burst write to NS9750B-A1 timing**



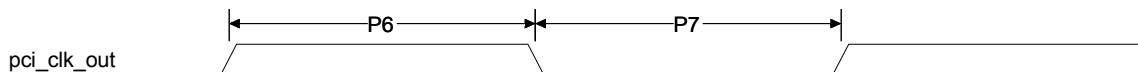
**PCI burst read to NS9750B-A1 timing**



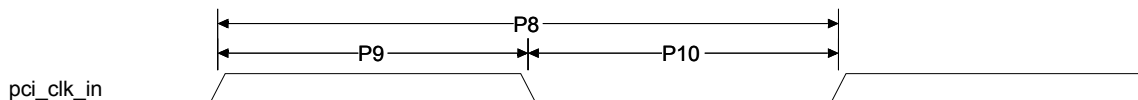
**Note:**

The functional timing for valid read data on ad[31:0] is just an example. The actual response time will depend on when the PCI bridge gets access to the AHB bus internal to NS9750B-A1.

**pci\_clk\_out timing**



**pci\_clk\_in timing**



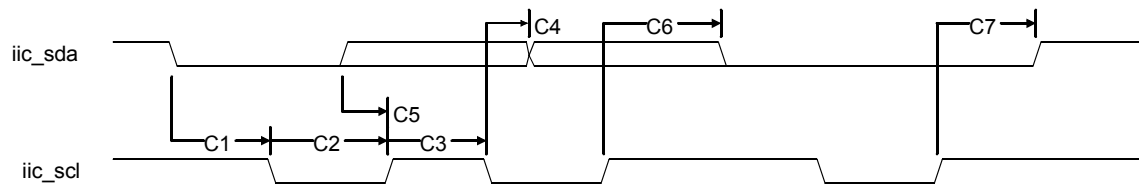
## I<sup>2</sup>C timing

I<sup>2</sup>C AC characteristics are measured with 10pF, unless otherwise noted.

Table 32 describes the values shown in the I<sup>2</sup>C timing diagram.

Parm	Description	Standard mode		Fast mode		Unit
		Min	Max	Min	Max	
C1	iic_sda to iic_scl START hold time	4.0		0.6		μs
C2	iic_scl low period	4.7		1.3		μs
C3	iic_scl high period	4.7		1.3		μs
C4	iic_scl to iic_sda DATA hold time	0		0		μs
C5	iic_sda to iic_scl DATA setup time	250		100		ns
C6	iic_scl to iic_sda START setup time	4.7		0.6		μs
C7	iic_scl to iic_sda STOP setup time	4.0		0.6		μs

**Table 32: I<sup>2</sup>C timing parameters**



## LCD timing

LCD AC characteristics are measured with 10pF, unless otherwise noted.

Table 33 describes the values shown in the LCD timing diagrams.

Parameter	Description	Register	Value	Units
L1	Horizontal front porch blanking	LCDDTiming0	HFP+1	CLCP periods
L2	Horizontal sync width	LCDDTiming0	HSW+1	CLCP periods
L3	Horizontal period	N/A	L1+L2+L15+L4	CLCP periods
L4	Horizontal backporch	LCDDTiming0	HBP+1	CLCP periods
L5	TFT active line	LCDDTiming0	16*(PPL+1) (see note 3)	CLCP periods
L6	LCD panel clock frequency	LCDDTiming1	<b>For BCD=0:</b> CLCDCLK/(PCD+2) <b>For BCD=1:</b> CLCDCLK (see note 1)	MHz
L7	TFT vertical sync width	LCDDTiming1	VSW+1	H lines
L8	TFT vertical lines/frame	N/A	L7+L9+L10+L11	H lines
L9	TFT vertical back porch	LCDDTiming1	VBP	H lines
L10	TFT vertical front porch	LCDDTiming1	VFP	H lines
L11	Active lines/frame	LCDDTiming1	LPP+1	H lines
L12	STN HSYNC inactive to VSYNC active	LCDDTiming0	HBP+1	CLCP periods
L13	STN vertical sync width	N/A	1	H lines
L14	STN vertical lines/frame	N/A	L11+L16	H lines
L15	STN active line	LCDDTiming2	CPL+1 (see note 4)	CLCP periods
L16	STN vertical blanking	LCDDTiming1	VSW+VFP+VBP+1	H lines
L17	STN CLCP inactive to HSYNC active	LCDDTiming0	HFP+1.5	CLCP periods
L18	CLCP to data/control (see notes 7 and 8)		-1.0 (min) +1.5 (max)	ns
L19	CLCP high (see notes 8, 9)		50%±0.5ns	ns
L20	CLCP low (see notes 8, 9)		50%±0.5ns	ns
L21	TFT VSYNC active to HSYNC active (see note 8)		-0.1ns (min) +0.1ns (max)	ns
L22	TFT VSYNC active to HSYNC inactive	LCDDTiming0	HSW	CLCP periods

**Table 33: LCD timing parameters**

Parameter	Description	Register	Value	Units
L23	STN VSYNC active to HSYNC inactive	LCDTiming0	<b>STN color:</b> 14+HSW+HFP <b>STN Mono8:</b> 6+HSW+HFP <b>STN Mono4:</b> 10+HSW+HFP	CLCP periods
L24	STN HSYNC inactive to VSYNC inactive	LCDTiming0	HBP+1	CLCP periods
L25	STN VSYNC inactive to HSYNC active	LCDTiming0	<b>STN color:</b> HFP+13 <b>STN Mono8:</b> HFP+15 <b>STN Mono4:</b> HFP+9	CLCP periods
L26	CLCP period		12.5 ns (min)	ns

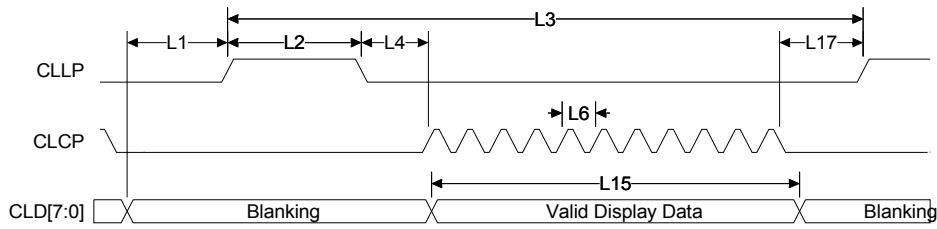
**Table 33: LCD timing parameters**

**Notes:**

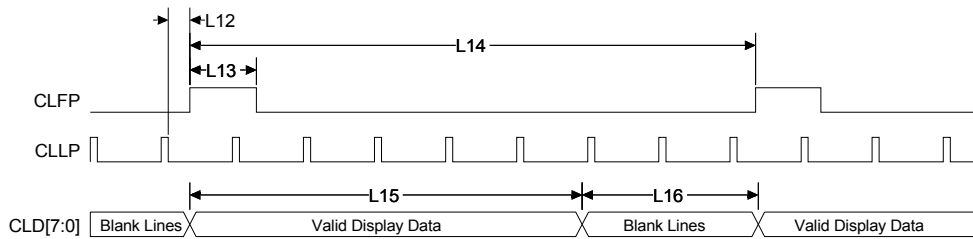
- CLCDCLK is selected from 5 possible sources:
  - lcdclk/2 (lcdclk is an external oscillator)
  - AHB clock
  - AHB clock/2
  - AHB clock/4
  - AHB clock/8

See the LCD chapter in the *NS9750B-A1 Hardware Reference* for acceptable clock frequencies for the different display configurations.
- The polarity of CLLP, CLFP, CLCP, and CLAC can be inverted using control fields in the LCDTiming1 register.
- The CPL field in the LCDTiming2 register must also be programmed to T5-1 (see the LCD chapter in the *NS9750B-A1 Hardware Reference*).
- The PPL field in the LCDTiming0 register must also be programmed correctly (see the LCD chapter in the *NS9750B-A1 Hardware Reference*).
- These data widths are supported:
  - 4-bit mono STN single panel
  - 8-bit mono STN single panel
  - 8-bit color STN single panel
  - 4-bit mono STN dual panel (8 bits to LCD panel)
  - 8-bit mono STN dual panel (16 bits to LCD panel)
  - 8-bit color STN dual panel (16 bits to LCD panel)
  - 24-bit TFT
  - 18-bit TFT
- See the LCD chapter in the *NS9750B-A1 Hardware Reference* for definitions of these bit fields.
- Note that data is sampled by the LCD panel on the falling edge of the CLCP in “LCD output timing” on page 70. If the polarity of CLCP is inverted, this parameter is relative to CLCP falling.
- $C_{load} = 10\text{pf}$  on all outputs.
- CLCP high and low times specified as 50% of the clock period  $\pm 0.5\text{ns}$ .
- Maximum allowable LCD panel clock frequency is 80 MHz.

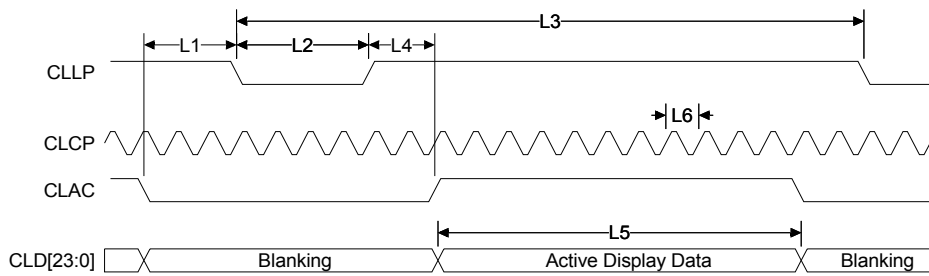
**Horizontal timing for STN displays**



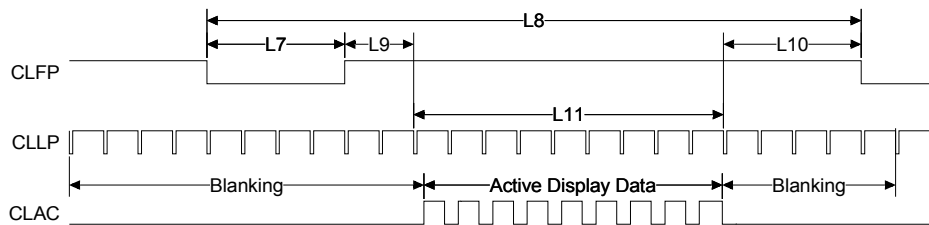
**Vertical timing for STN displays**



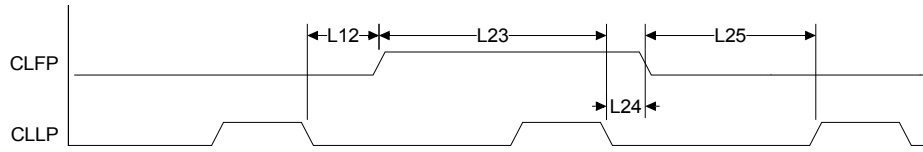
**Horizontal timing for TFT displays**



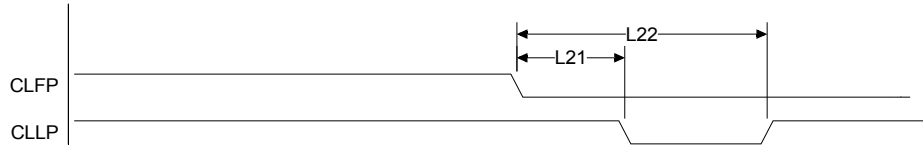
**Vertical timing for TFT displays**



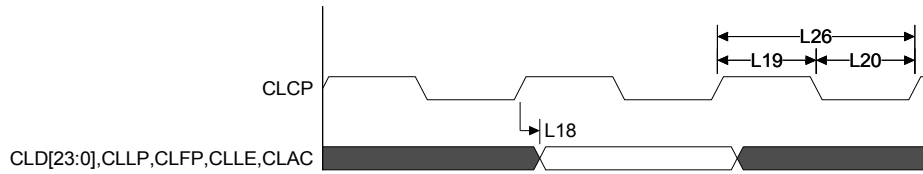
***HSYNC vs VSYNC timing for STN displays***



***HSYNC vs VSYNC timing for TFT displays***



***LCD output timing***



## SPI timing

SPI AC characteristics are measured with 10pF, unless otherwise noted.

Table 34 describes the values shown in the SPI timing diagrams.

Parm	Description	Min	Max	Unit	Modes	Notes
<b>SPI master parameters</b>						
SP0	SPI enable low setup to first SPI CLK out rising	$3 \cdot T_{BCLK} - 10$		ns	0, 3	1, 3
SP1	SPI enable low setup to first SPI CLK out falling	$3 \cdot T_{BCLK} - 10$		ns	1, 2	1, 3
SP3	SPI data in setup to SPI CLK out rising	30		ns	0, 3	
SP4	SPI data in hold from SPI CLK out rising	0		ns	0, 3	
SP5	SPI data in setup to SPI CLK out falling	30		ns	1, 2	
SP6	SPI data in hold from SPI CLK out falling	0		ns	1, 2	
SP7	SPI CLK out falling to SPI data out valid		10	ns	0, 3	6
SP8	SPI CLK out rising to SPI data out valid		10	ns	1, 2	6
SP9	SPI enable low hold from last SPI CLK out falling	$3 \cdot T_{BCLK} - 10$		ns	0, 3	1, 3
SP10	SPI enable low hold from last SPI CLK out rising	$3 \cdot T_{BCLK} - 10$		ns	1, 2	1, 3
SP11	SPI CLK out high time	$SP13 \cdot 45\%$	$SP13 \cdot 55\%$	ns	0, 1, 2, 3	4
SP12	SPI CLK out low time	$SP13 \cdot 45\%$	$SP13 \cdot 55\%$	ns	0, 1, 2, 3	4
SP13	SPI CLK out period	$T_{BCLK} \cdot 6$		ns	0, 1, 2, 3	3
<b>SPI slave parameters</b>						
SP14	SPI enable low setup to first SPI CLK in rising	30		ns	0, 3	1
SP15	SPI enable low setup to first SPI CLK in falling	30		ns	1, 2	1
SP16	SPI data in setup to SPI CLK in rising	0		ns	0, 3	
SP17	SPI data in hold from SPI CLK in rising	60		ns	0, 3	
SP18	SPI data in setup to SPI CLK in falling	0		ns	1, 2	
SP19	SPI data in hold from SPI CLK in falling	60		ns	1, 2	
SP20	SPI CLK in falling to SPI data out valid	20	70	ns	0, 3	6
SP21	SPI CLK in rising to SPI data out valid	20	70	ns	1, 2	6
SP22	SPI enable low hold from last SPI CLK in falling	15		ns	0, 3	1
SP23	SPI enable low hold from last SPI CLK in rising	15		ns	1, 2	1
SP24	SPI CLK in high time	$SP26 \cdot 40\%$	$SP26 \cdot 60\%$	ns	0, 1, 2, 3	5
SP25	SPI CLK in low time	$SP26 \cdot 40\%$	$SP26 \cdot 60\%$	ns	0, 1, 2, 3	5

**Table 34: SPI timing parameters**

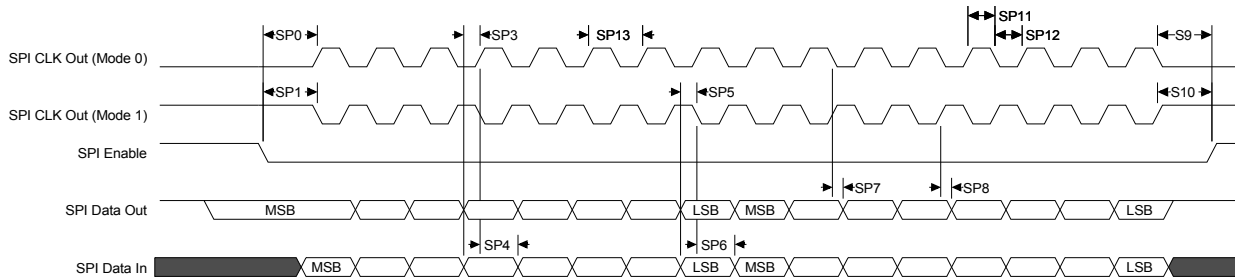
Parm	Description	Min	Max	Unit	Modes	Notes
SP26	SPI CLK in period	$T_{BCLK} * 10$		ns	0, 1, 2, 3	

**Table 34: SPI timing parameters**

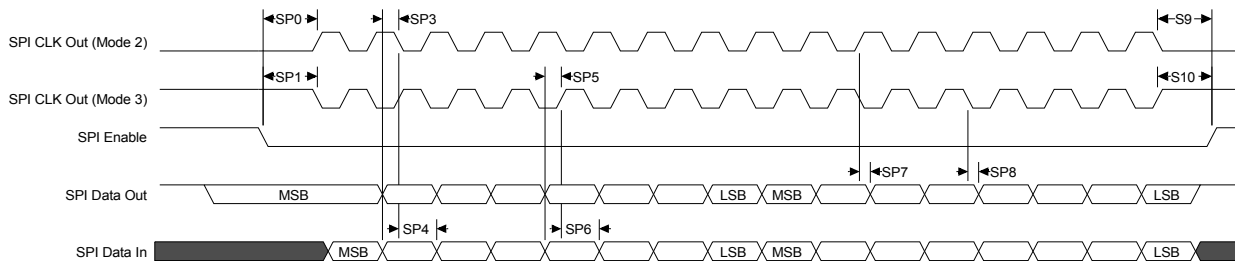
**Notes:**

- Active level of SPI enable is inverted (that is, 1) if the CSPOL bit in Serial Channel B/A/C/D Control Register B (see the *NS9750B-A1 Hardware Reference*) is set to 1. Note that in SPI slave mode, only a value of 0 (low enable) is valid; the SPI slave is fixed to an active low chip select.
- SPI data order is reversed (that is, LSB last and MSB first) if the BITORDR bit in Serial Channel B/A/C/D Control Register B (see the *NS9750B-A1 Hardware Reference*) is set to 0.
- $T_{BCLK}$  is period of BBus clock.
- $\pm 5\%$  duty cycle skew.
- $\pm 10\%$  duty cycle skew.
- $C_{load} = 10\text{pf}$  for all outputs.
- SPI data order can be reversed such that LSB is first. Use the BITORDR bit in Serial Channel B/A/C/D Control Register A (see the *NS9750B-A1 Hardware Reference*).

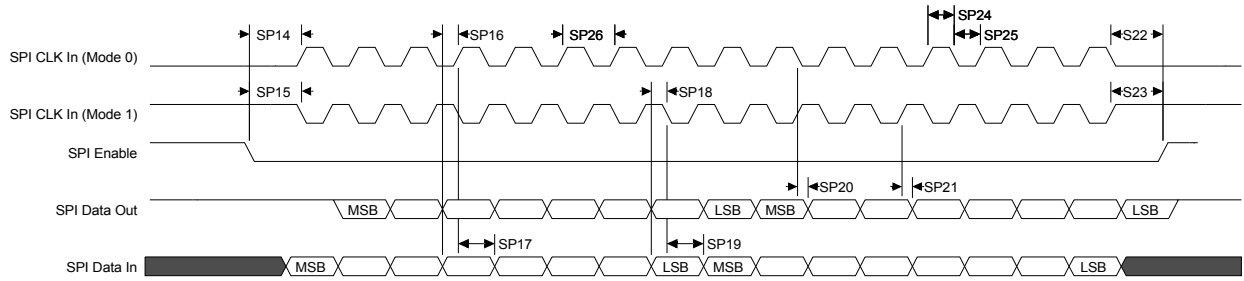
**SPI master mode 0 and 1: 2-byte transfer (see note 7)**



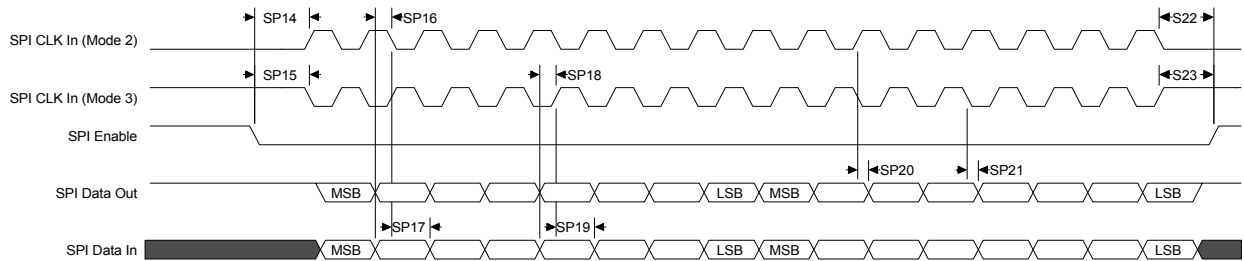
**SPI master mode 2 and 3: 2-byte transfer (see note 7)**



***SPI slave mode 0 and 1: 2-byte transfer (see note 7)***



***SPI slave mode 2 and 3: 2-byte transfer (see note 7)***



## IEEE 1284 timing

IEEE 1284 AC characteristics are measured with 10pF, unless otherwise noted.

Table 35 describes the values shown in the IEEE 1284 timing diagram.

Parameter	Description	Min	Max	Unit	Note
IE1	Busy-while-Strobe	0	500	ns	1
IE2	Busy high to nAck low	0		ns	
IE3	Busy high		1000	ns	2
IE4	nAck low		500	ns	3
IE5	nAck high to Busy low		500	ns	3

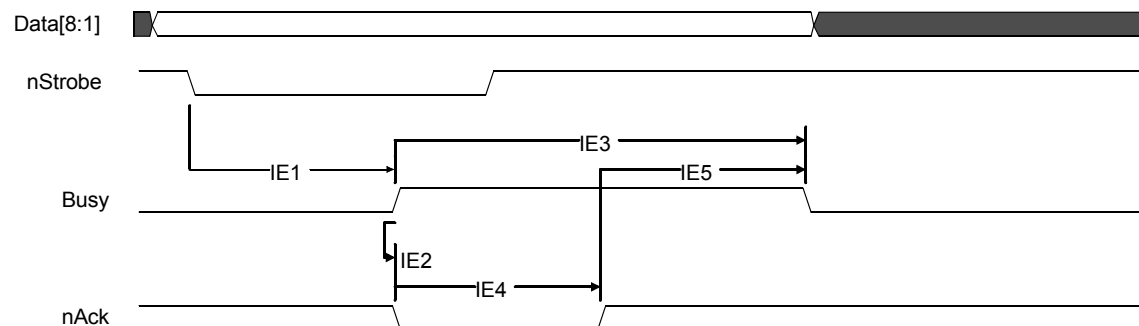
**Table 35: IEEE 1284 timing parameters**

### Notes:

- 1 The range is 0ns up to one time unit.
- 2 Two time units.
- 3 Three time units.

### IEEE 1284 timing example

The IEEE 1284 timing is determined by the BBus clock and the Granularity Count register (GCR) setting. In this example, the BBus clock is 50 MHz and the Granularity Count register is set to 25. The basic time unit is  $1/50 \text{ MHz} \times 25$ , which is 500ns.



## USB timing

Table 36 and Table 37 describe the values shown in the USB timing diagrams.

Parameter	Description	Min	Max	Unit	Notes
U1	Rise time (10%–90%)	4	20	ns	1
U2	Fall time (10%–90%)	4	20	ns	1
U3	Differential rise and fall time matching	90	111.11	%	2, 5
U4	Driver output resistance	28	44	ohms	3

**Table 36: USB full speed timing parameters**

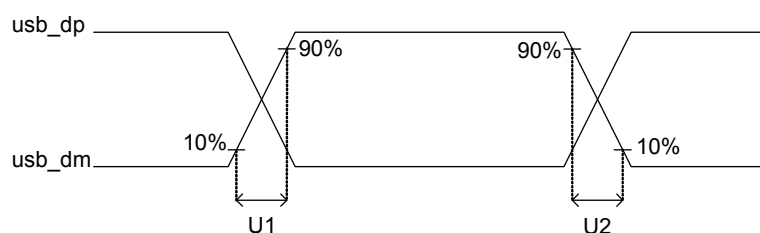
Parameter	Description	Min	Max	Unit	Notes
U1	Rise time (10%–90%)	75	300	ns	4
U2	Fall time (10%–90%)	75	300	ns	4
U3	Differential rise and fall time matching	80	125	%	2, 5

**Table 37: USB low speed timing parameters**

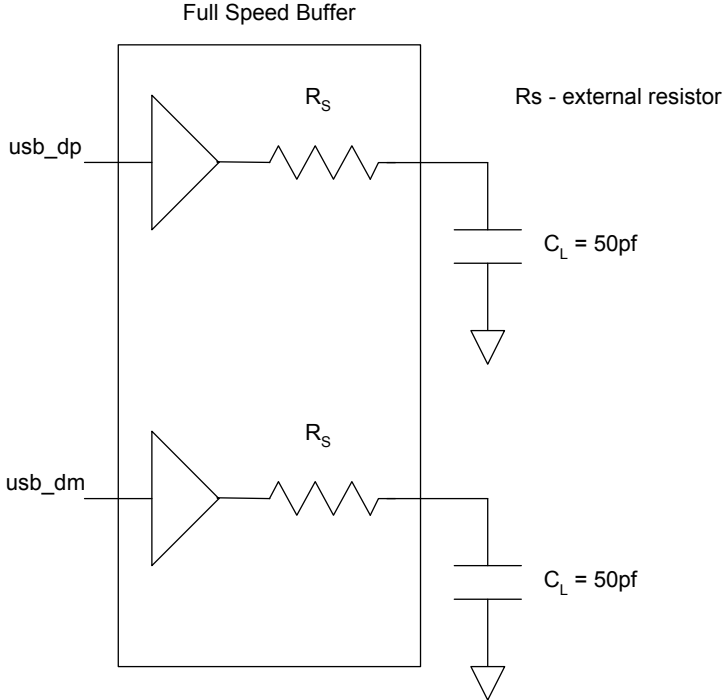
### Notes:

- 1 Load shown in "USB full speed load."
- 2 U1/U2.
- 3 Includes resistance of 27 ohm  $\pm$ 2 ohm external series resistor.
- 4 Load shown in "USB low speed load."
- 5 Excluding the first transition from the idle state.

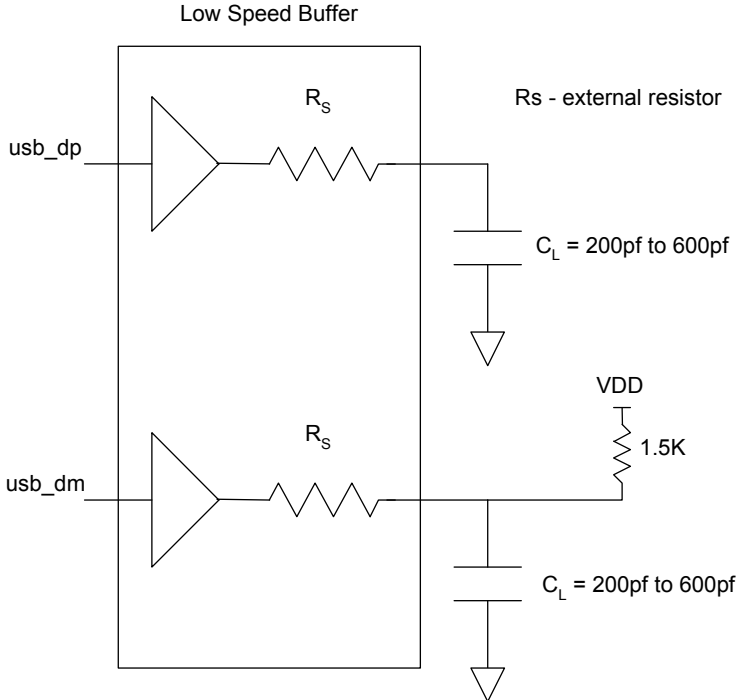
### USB differential data timing



**USB full speed load**



**USB low speed load**



## Reset and hardware strapping timing

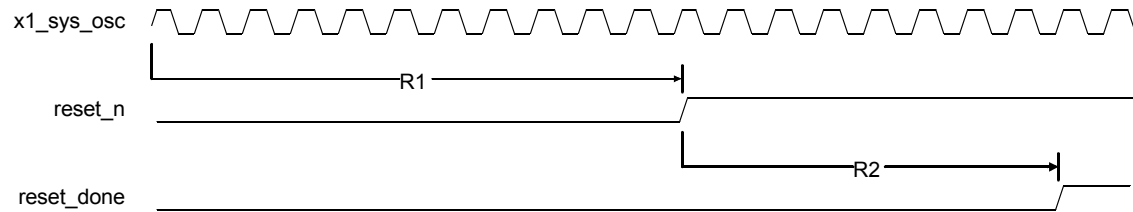
Reset and hardware strapping AC characteristics are measured with 10pF, unless otherwise noted. Table 38 describes the values shown in the reset and hardware strapping timing diagram.

Parameter	Description	Min	Max	Unit	Notes
R1	reset_n minimum time	10		x1_sys_osc clock cycles	1
R2	reset_n to reset_done		4	ms	

**Table 38: Reset and hardware strapping timing parameters**

### Note:

1 The hardware strapping pins are latched 5 clock cycles after reset\_n is deasserted (goes high).



- **R1:** reset\_n must be held low for a minimum of 10 x1\_sys\_osc clock cycles after power up.
- **R2:** reset\_done is asserted 4ms after reset\_n is driven high.

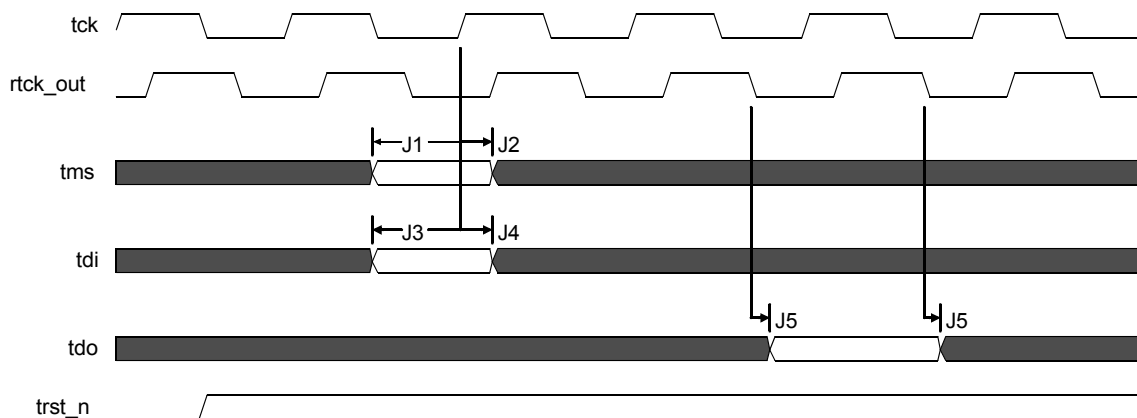
## JTAG timing

JTAG AC characteristics are measured with 10pF, unless otherwise noted.

Table 39 describes the values shown in the JTAG timing diagram.

Parameter	Description	Min	Max	Unit
J1	tms (input) setup to tck rising	5		ns
J2	tms (input) hold to tck rising	2		ns
J3	tdi (input) setup to tck rising	5		ns
J4	tdi (input) hold to tck rising	2		ns
J5	tdo (output) to tck falling	2.5	10	ns

**Table 39: JTAG timing parameters**



**Notes:**

- 1 Maximum tck rate is 10 MHz.
- 2 rtck\_out is an asynchronous output, driven off of the CPU clock.
- 3 trst\_n is an asynchronous input.

## Clock timing

Clock AC characteristics are measured with 10pF, unless otherwise noted.

The next three timing diagrams pertain to clock timing.

### USB crystal/external oscillator timing

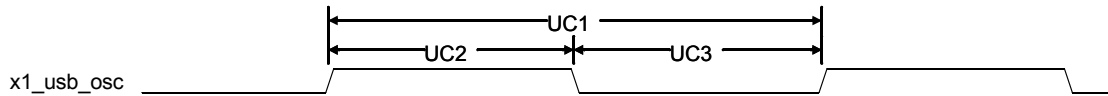
Table 40 describes the values shown in the USB crystal/external oscillator timing diagram.

Parameter	Description	Min	Max	Unit	Notes
UC1	x1_usb_osc cycle time	20.831	20.835	ns	1
UC2	x1_usb_osc high time	$(UC1/2) \times 0.4$	$(UC1/2) \times 0.6$	ns	
UC3	x1_usb_osc low time	$(UC1/2) \times 0.4$	$(UC1/2) \times 0.6$	ns	

**Table 40: USB crystal/external oscillator timing parameters**

#### Note:

- 1 If using a crystal, the tolerance must be  $\pm 100$  ppm or better.



### LCD input clock

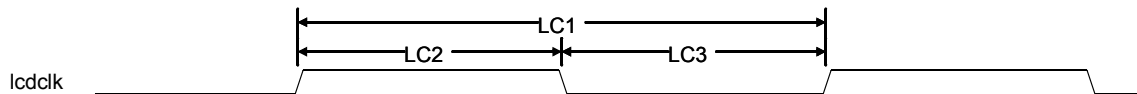
Table 41 describes the values shown for the LCD input clock timing diagram.

Parameter	Description	Min	Max	Unit	Notes
LC1	lcdclk cycle time	6.25		ns	1
LC2	lcdclk high time	$(LC1/2) \times 0.4$	$(LC1/2) \times 0.6$	ns	
LC3	lcdclk low time	$(LC1/2) \times 0.4$	$(LC1/2) \times 0.6$	ns	

**Table 41: LCD input clock timing parameters**

#### Note:

- 1 The clock rate supplied on lcdclk is twice the actual LCD clock rate.

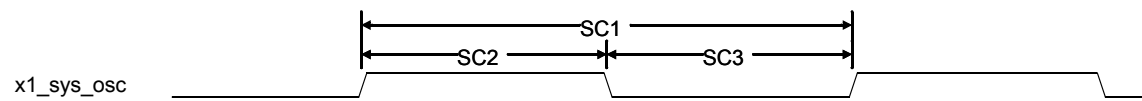


***System PLL reference clock timing***

Table 42 describes the values shown in the system PLL reference clock timing diagram.

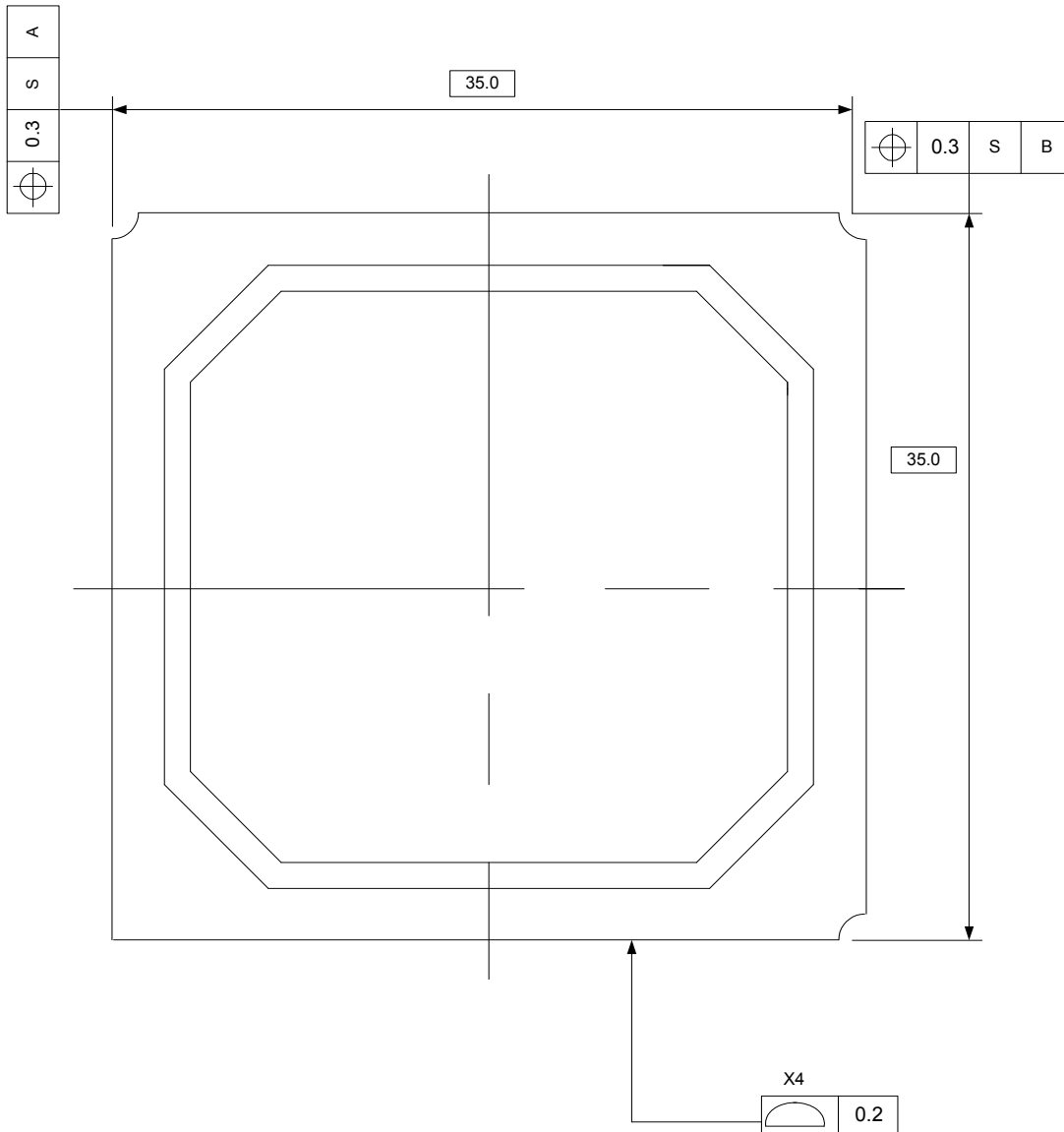
Parameter	Description	Min	Max	Unit
SC1	x1_sys_osc cycle time	25	50	ns
SC2	x1_sys_osc high time	$(SC1/2) \times 0.45$	$(SC1/2) \times 0.55$	ns
SC3	x1_sys_osc low time	$(SC1/2) \times 0.45$	$(SC1/2) \times 0.55$	ns

***Table 42: System PLL reference clock timing parameters***



## Packaging

The NS9750B-A1 dimensions and pinout are shown in the next two diagrams.



**Figure 8: NS9750B-A1 top view**

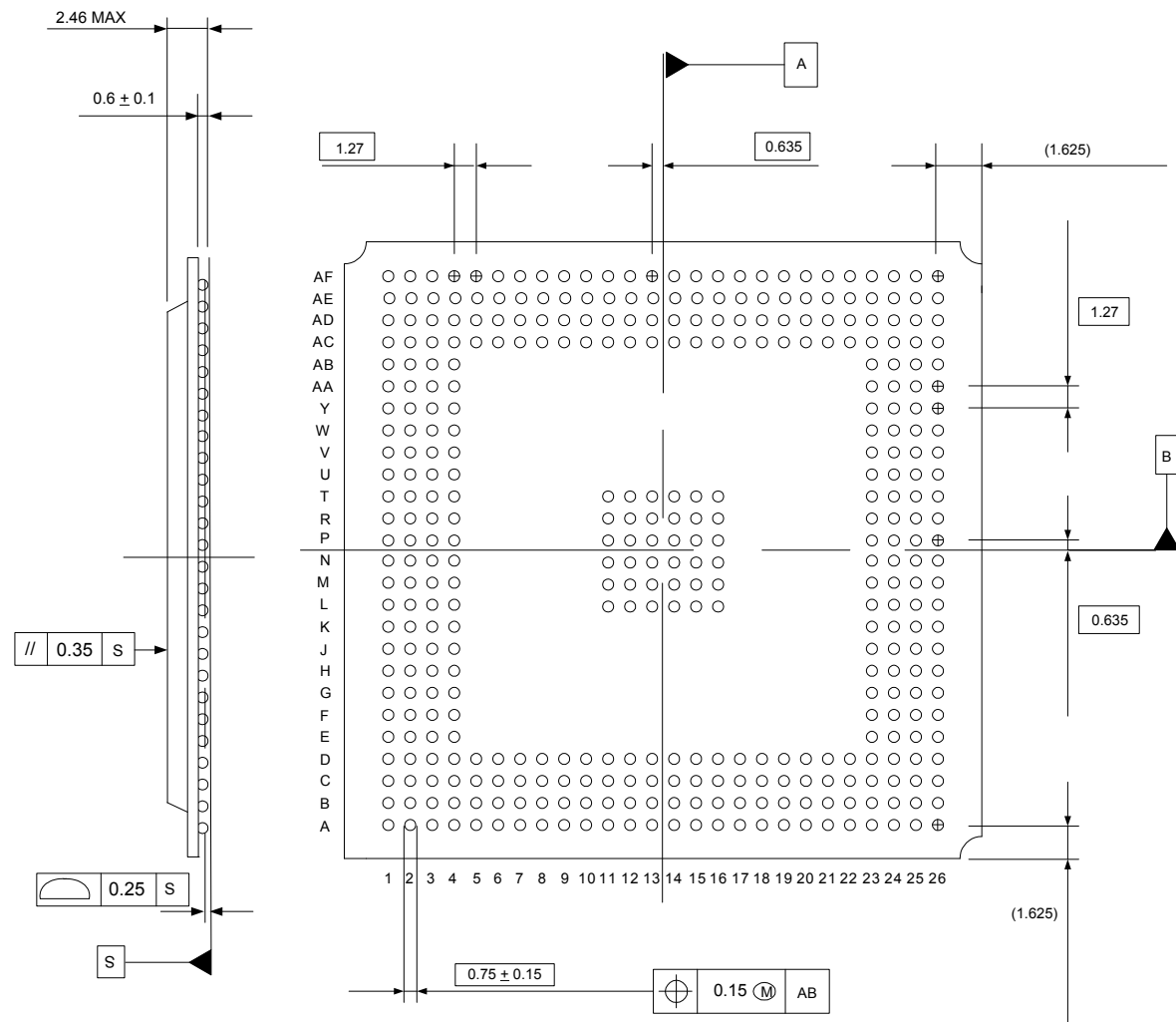


Figure 9: NS9750B-A1 bottom and side view

Figure 10 shows the layout of the NS9750B-A1, for use in setting up the board.

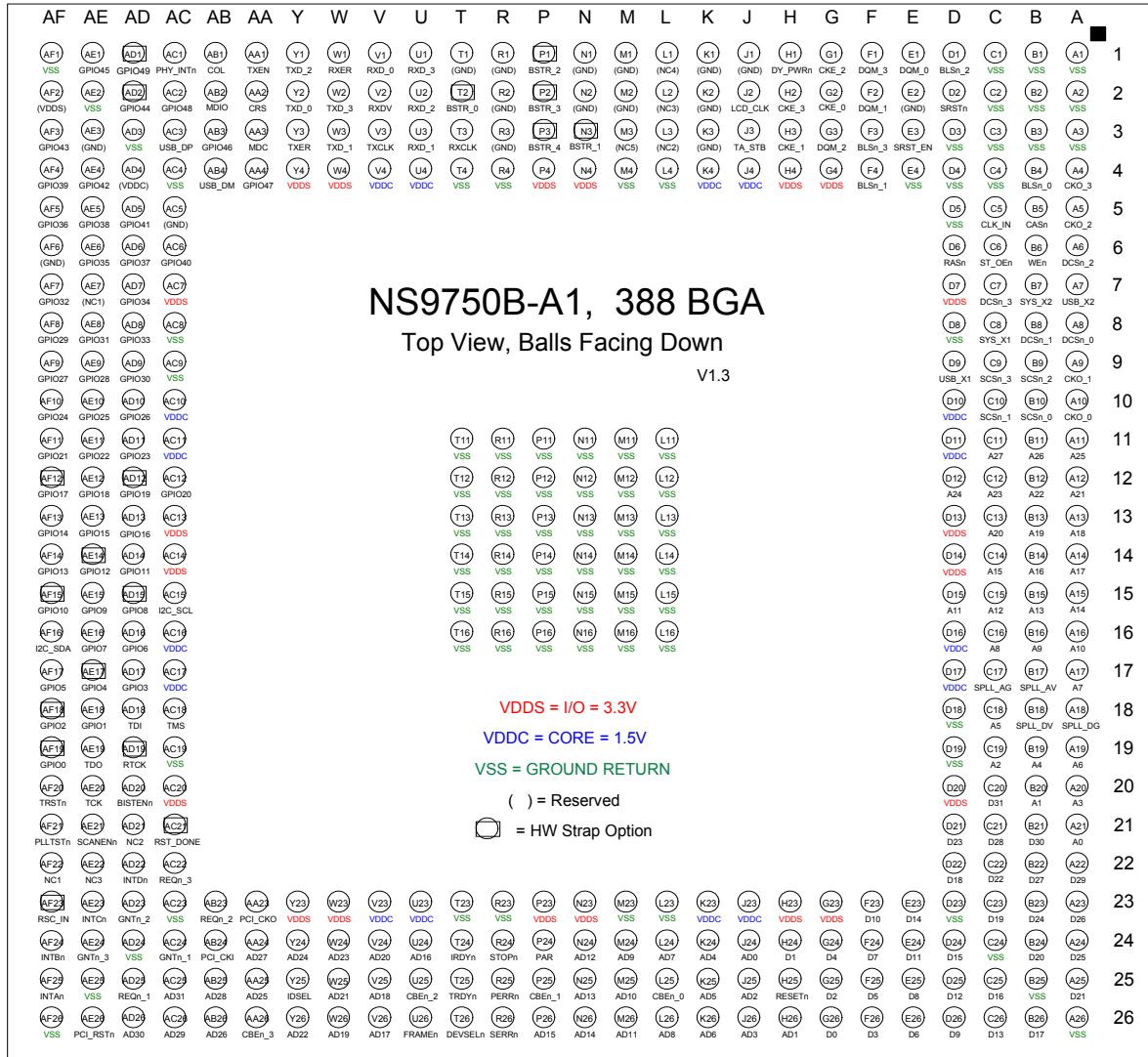


Figure 10: NS9750B-A1 BGA layout

For information about hardware strapping options, see Table 1, “Configuration pins– Bootstrap initialization,” on page 5.

## Product specifications

These tables provide additional information about the NS9750B-A1.

ROHS substance	PPM level
Lead	0
Mercury	0
Cadmium	0
Hexavalent Chromium	0
Polybrominated biphenyls	0
Polybrominated diphenyl ethers	0

**Table 43: RoHS specifications**

Component	Weight [mg]	Material		Weight [mg]	Weight [%]
		CAS no.	Name		
Chip	27.037	7440-21-3	Si	27.0370	0.61
Frame	1841.616	223769-10-6	Epoxy resin	865.5600	19.71
		7440-50-8	Cu	736.6500	16.77
		7440-02-0	Ni	9.2100	0.21
		7440-57-5	Au	1.8400	0.04
			Other	228.3560	5.20
Bonding wire	6.990	7440-57-5	Au	6.9900	0.16
Ag paste	3.400	7440-22-4	Ag	2.6200	0.06
			Epoxy, other	0.7800	0.02
Epoxy resin	1920.177	60676-86-0	Silica (SiO <sub>2</sub> )	1747.3570	39.79
			Epoxy, other	86.4100	1.97
			Phenol Resin	86.4100	1.97
		<b>CAS no.</b>	<b>Name</b>		
Solder ball	592.400	7440-31-5	Sn	571.6700	13.02
<b>Digi International</b>		7440-22-4	Ag	17.7700	0.40
<b>11001 Bren Road East</b>		7440-50-8	Cu	2.9600	0.07
<b>Minnetonka, MN 55343 U.S.A.</b>					
<b>United States: +1 877 912-3444</b>					
<b>Other regions: +1 952 912-3444</b>					
<b>Fax: +1 952 912-4960</b>					
<b>www.digi.com/support</b>					
<b>www.digi.com</b>					

P/N: 91001324\_B

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