



CYPRESS

CY7C67200

EZ-OTG™

Programmable USB On-The-Go Host/Peripheral Controller



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1.0 INTRODUCTION

EZ-OTG™ (CY7C67200) is Cypress Semiconductor's first USB On-The-Go (OTG) host/peripheral controller. EZ-OTG is designed to easily interface to most high-performance CPUs to add USB host functionality. EZ-OTG has its own 16-bit RISC processor to act as a coprocessor or operate in standalone mode. EZ-OTG also has a programmable I/O interface block allowing a wide range of interface options.

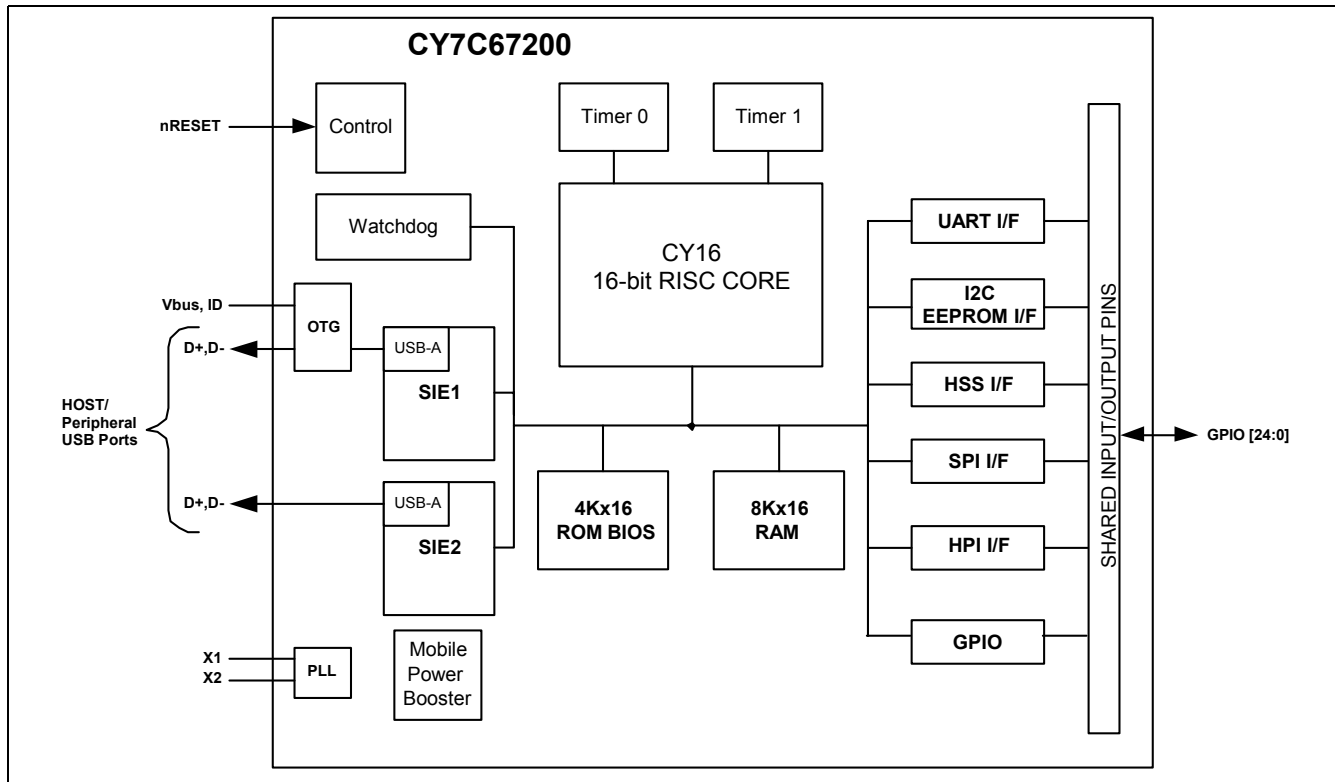


Figure 1-1. Block Diagram

1.1 EZ-OTG Features

- Single-chip programmable USB dual role (Host/Peripheral) controller with two configurable Serial Interface Engines (SIEs) and two USB ports
- Support for USB OTG protocol
- On-chip 48-MHz 16-bit processor with dynamically switchable clock speed
- Configurable I/O block supporting a variety of I/O options or up to 25 bits of General Purpose I/O (GPIO)
- 4K × 16 internal mask ROM containing built-in BIOS that supports a communication-ready state with access to I2C EEPROM interface, external ROM, UART, or USB
- 8K x 16 internal RAM for code and data buffering
- 16-bit parallel host port interface (HPI) with DMA/Mailbox data path for an external processor to directly access all on-chip memory and control on-chip SIEs
- Fast serial port supports from 9600 baud to 2.0 Mbaud
- SPI supporting both master and slave
- Supports 12-MHz external crystal or clock
- Power consumption: 50 mA operational; 30 mA standby
- 2.7V to 3.6V power supply voltage
- Package option — 48-pin FBGA

2.0 Typical Applications

EZ-OTG is a very powerful and flexible dual-role USB controller that supports a wide variety of applications. It is primarily intended to enable USB OTG capability in applications such as:

- Cellular phones
- PDAs and pocket PCs
- Video and digital still cameras
- MP3 players
- Mass storage devices.

3.0 Functional Overview

3.1 Processor Core

3.1.1 Processor

EZ-OTG has a general-purpose 16-bit embedded RISC processor that runs at 48 MHz.

3.1.2 Clocking

EZ-OTG requires a 12-MHz source for clocking. Either an external crystal or TTL-level oscillator may be used. EZ-OTG has an internal PLL that produces a 48-MHz internal clock from the 12-MHz source.

3.1.3 Memory

EZ-OTG has a built-in 4K × 16 masked ROM and a 8K × 16 internal RAM. The masked ROM contains the EZ-OTG BIOS. The internal RAM can be used for program code or data.

3.1.4 Interrupts

EZ-OTG provides 128 interrupt vectors. The first 48 vectors are hardware interrupts and the following 80 vectors are software interrupts.

3.1.5 General Timers and Watchdog Timer

EZ-OTG has two built-in programmable timers and a Watchdog timer. All three timers can generate an interrupt to the EZ-OTG.

3.1.6 Power Management

EZ-OTG has one main power-saving mode, Sleep. Sleep mode pauses all operations and provides the lowest power state.

4.0 Interface Descriptions

EZ-OTG has a variety of interface options for connectivity, with several interface options available. See *Table 4-1* to understand how the interfaces share pins and can coexist. Below are some general guidelines:

- I²C EEPROM and OTG do not conflict with any interfaces
- HPI is mutually exclusive to: HSS, SPI, and UART.

Table 4-1. Interface Options for GPIO Pins

| GPIO Pins | HPI | HSS | SPI | UART | I2C | OTG |
|-----------|-----|-----|------|------|---------|-------|
| GPIO31 | | | | | SCL/SDA | |
| GPIO30 | | | | | SCL/SDA | |
| GPIO29 | | | | | | OTGID |
| GPIO24 | INT | | | | | |
| GPIO23 | nRD | | | | | |
| GPIO22 | nWR | | | | | |
| GPIO21 | nCS | | | | | |
| GPIO20 | A1 | | | | | |
| GPIO19 | A0 | | | | | |
| GPIO15 | D15 | CTS | | | | |
| GPIO14 | D14 | RTS | | | | |
| GPIO13 | D13 | RXD | | | | |
| GPIO12 | D12 | TXD | | | | |
| GPIO11 | D11 | | MOSI | | | |
| GPIO10 | D10 | | SCK | | | |
| GPIO9 | D9 | | nSSI | | | |
| GPIO8 | D8 | | MISO | | | |
| GPIO7 | D7 | | | TX | | |
| GPIO6 | D6 | | | RX | | |
| GPIO5 | D5 | | | | | |
| GPIO4 | D4 | | | | | |
| GPIO3 | D3 | | | | | |
| GPIO2 | D2 | | | | | |
| GPIO1 | D1 | | | | | |
| GPIO0 | D0 | | | | | |

4.1 USB Interface

EZ-OTG has two built-in Host/Peripheral SIEs that each have a single USB transceiver, meeting the USB 2.0 specification requirements for full- and low-speed (high-speed is not supported). In Host mode, EZ-OTG supports two downstream ports, each support control, interrupt, bulk, and isochronous transfers. In Peripheral mode, EZ-OTG supports one peripheral port with eight endpoints for each of the two SIEs. Endpoint 0 is dedicated as the control endpoint and only supports control transfers. Endpoints 1 through 7 support Interrupt, Bulk (up to 64 Bytes/packet), or Isochronous transfers (up to 1023 Bytes/packet size). EZ-OTG also supports a combination of Host and Peripheral ports simultaneously. EZ-OTG also supports a combination of Host and Peripheral ports simultaneously as shown in *Table 4-2*.

Table 4-2. USB Port Configuration Options

| Port Configurations | Port 1A | Port 2A |
|-----------------------|------------|------------|
| OTG | OTG | – |
| OTG + 1 Host | OTG | Host |
| OTG + 1 Peripheral | OTG | Peripheral |
| 1 Host + 1 Peripheral | Host | Peripheral |
| 1 Host + 1 Peripheral | Peripheral | Host |
| 2 Hosts | Host | Host |
| 1 Host | Host | – |
| 1 Host | – | Host |
| 2 Peripherals | Peripheral | Peripheral |
| 1 Peripheral | Peripheral | – |
| 1 Peripheral | – | Peripheral |

4.1.1 USB Features

- USB 2.0-compatible for full and low speed
- Up to two downstream USB host ports
- Up to two upstream USB peripheral ports
- Configurable endpoint buffers (pointer and length), must reside in internal RAM
- Up to eight available peripheral endpoints (1 control endpoint)
- Supports Control, Interrupt, Bulk, and Isochronous transfers
- Internal DMA channels for each endpoint
- Internal pull-up and pull-down resistors
- Internal Series termination resistors on USB data lines

4.1.2 USB Pins.
Table 4-3. USB Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| DM1A | F2 |
| DP1A | E3 |
| DM2A | C2 |
| DP2A | D3 |

4.2 OTG Interface

EZ-OTG has one USB port that is compatible with the USB On-The-Go supplement to the USB 2.0 specification. The USB OTG port has a various hardware features to support Session Request Protocol (SRP) and Host Negotiation Protocol (HNP). OTG is only supported on USB PORT 1A.

4.2.1 OTG Features

- Internal Charge Pump to supply and control VBUS
- VBUS Valid Status (above 4.4V)
- VBUS Status for 2.4V < VBUS < 0.8V
- ID Pin Status
- Switchable 2K Ω internal discharge resistor on VBUS
- Switchable 500 Ω internal Pull-up resistor on VBUS
- Individually switchable internal Pull-up and Pull-down resistors on the USB Data Lines

4.2.2 OTG Pins.

Table 4-4. OTG Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| DM1A | F2 |
| DP1A | E3 |
| OTGVBUS | C1 |
| OTGID | F4 |
| CSwitchA | D1 |
| CSwitchB | D2 |

4.3 General Purpose I/O Interface

EZ-OTG has up to 25 GPIO signals available. Several other optional interfaces use GPIO pins as well and may reduce the overall number of available GPIOs.

4.3.1 GPIO Description

All Inputs are sampled asynchronously with state changes occurring at a rate of up to two 48-MHZ clock cycles. GPIO pins are latched directly into registers, a single flip-flop.

4.3.2 Unused Pin Descriptions

Unused USB pins should be tri-stated with the D+ line pulled high through the internal pull-up resistor and the D- line pulled low through the internal pull-down resistor.

Unused GPIO pins should be configured as outputs and driven low.

4.4 UART Interface

EZ-OTG has a built-in UART interface. The UART interface supports data rates from 900 to 115.2K baud. It can be used as a development port or for other interface requirements. The UART interface is exposed through GPIO pins.

4.4.1 UART Features

- Supports baud rates of 900 to 115.2K
- 8-N-1

4.4.2 UART Pins.

Table 4-5. UART Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| TX | B5 |
| RX | B4 |

4.5 I²C EEPROM Interface

EZ-OTG provides a master only I²C interface for external serial EEPROMs. The serial EEPROM can be used to store application specific code and data. This I²C interface is only to be used for loading code out of EEPROM, it is not a general I²C interface. The I²C EEPROM interface is a BIOS implementation and is exposed through GPIO pins. Please refer to the BIOS documentation for additional details on this interface.

4.5.1 I²C EEPROM Features

- Supports EEPROMs up to 64 KB (512K bit)
- Auto-detection of EEPROM size

4.5.2 I²C EEPROM Pins.

Table 4-6. I²C EEPROM Interface Pins

| Pin Name | Pin Number |
|---------------------|------------|
| SMALL EEPROM | |
| SCK | H3 |
| SDA | F3 |
| LARGE EEPROM | |
| SCK | F3 |
| SDA | H3 |

4.6 Serial Peripheral Interface

EZ-OTG provides a SPI interface for added connectivity. EZ-OTG may be configured as either an SPI master or SPI slave. The SPI interface can be exposed through GPIO pins or the External Memory port.

4.6.1 SPI Features

- Master or slave mode operation
- DMA block transfer and PIO byte transfer modes
- Full duplex or half duplex data communication
- 8-byte receive FIFO and 8-byte transmit FIFO
- Selectable master SPI clock rates from 250 KHz to 12 MHz
- Selectable master SPI clock phase and polarity
- Slave SPI signaling synchronization and filtering
- Slave SPI clock rates up to 2 MHz
- Maskable interrupts for block and byte transfer modes
- Individual bit transfer for non-byte aligned serial communication in PIO mode
- Programmable delay timing for the active/in-active master SPI clock
- Auto or manual control for master mode slave select signal
- Complete access to internal memory

4.6.2 SPI Pins

The SPI port has a few different pin location options as shown in *Table 4-7*. The pin location is selectable via the GPIO Control Register [0xC006].

Table 4-7. SPI Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| nSSI | F6 or C6 |
| SCK | D5 |
| MOSI | D4 |
| MISO | C5 |

4.7 High-Speed Serial Interface

EZ-OTG provides an HSS interface. The HSS interface is a programmable serial connection with baud rate from 9600 baud to 2 Mbaud. The HSS interface supports both byte and block mode operations as well as hardware and software handshaking. Complete control of EZ-OTG can be accomplished through this interface via an extensible API and communication protocol. The HSS interface can be exposed through GPIO pins or the External Memory port.

4.7.1 HSS Features

- 8-bit, no parity code
- Programmable baud rate from 9600 baud to 2 Mbaud
- Selectable 1- or 2-stop bit on transmit
- Programmable inter-character gap timing for Block Transmit
- 8-byte receive FIFO
- Glitch filter on receive
- Block mode transfer directly to/from EZ-OTG internal memory (DMA transfer)

- Selectable CTS/RTS hardware signal handshake protocol
- Selectable XON/XOFF software handshake protocol
- Programmable Receive interrupt, Block Transfer Done interrupts
- Complete access to internal memory

4.7.2 HSS Pins

Table 4-8. HSS Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| CTS | F6 |
| RTS | E4 |
| RX | E5 |
| TX | E6 |

4.8 Host Port Interface (HPI)

EZ-OTG has an HPI interface. The HPI interface provides DMA access to the EZ-OTG internal memory by an external host, plus a bidirectional mailbox register for supporting high-level communication protocols. This port is designed to be the primary high-speed connection to a host processor. Complete control of EZ-OTG can be accomplished through this interface via an extensible API and communication protocol. Other than the HW communication protocols, a host processor has identical control over EZ-Host whether connecting to the HPI or HSS port. The HPI interface is exposed through GPIO pins.

4.8.1 HPI Features

- 16-bit data bus Interface
- 16 MB/s throughput
- Auto-Increment of address pointer for fast block mode transfers
- Direct memory access (DMA) to internal memory
- Bidirectional Mailbox register
- Byte Swapping
- Complete access to internal memory
- Complete control of SIEs through HPI
- Dedicated HPI Status Register

4.8.2 HPI Pins

Table 4-9. HPI Interface Pins ^[1, 2]

| Pin Name | Pin Number |
|----------|------------|
| INT | H4 |
| nRD | G4 |
| nWR | H5 |
| nCS | G5 |
| A1 | H6 |
| A0 | F5 |
| D15 | F6 |
| D14 | E4 |
| D13 | E5 |
| D12 | E6 |
| D11 | D4 |
| D10 | D5 |
| D9 | C6 |
| D8 | C5 |
| D7 | B5 |

Notes:

1. HPI_INT is for the Outgoing Mailbox Interrupt.
2. HPI strobes are negative logic sampled on rising edge.

Table 4-9. HPI Interface Pins (continued)^[1, 2]

| | |
|----|----|
| D6 | B4 |
| D5 | C4 |
| D4 | B3 |
| D3 | A3 |
| D2 | C3 |
| D1 | A2 |
| D0 | B2 |

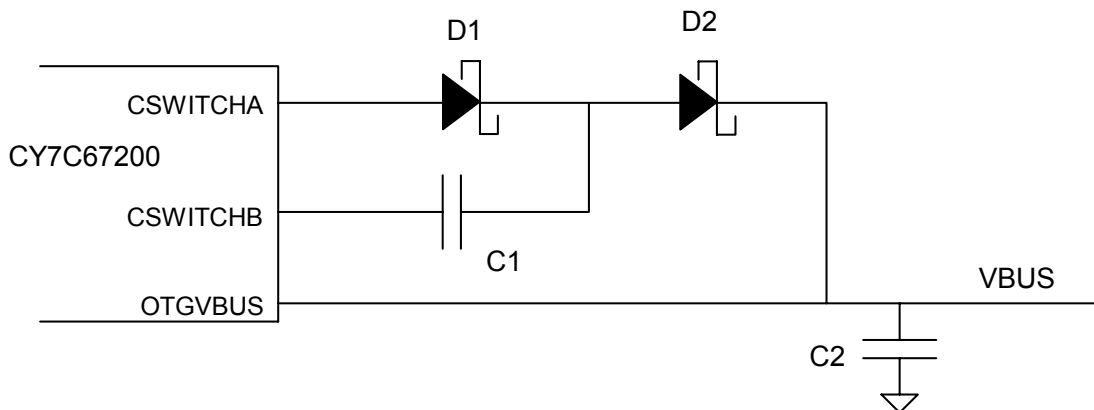
The two HPI address pins are used to address one of four possible HPI port registers as shown in *Table 4-10* below.

Table 4-10. HPI Addressing

| HPI A[1:0] | A1 | A0 |
|-------------|----|----|
| HPI Data | 0 | 0 |
| HPI Mailbox | 0 | 1 |
| HPI Address | 1 | 0 |
| HPI Status | 1 | 1 |

4.9 Charge Pump Interface

VBUS for the USB On-The-Go (OTG) port can be produced by EZ-OTG using its built-in charge pump and some external components. The circuit connections should look similar to the diagram below.


Figure 4-1. Charge Pump

Component details:

- D1 and D2: Schottky diodes with a current rating greater than 60 mA
- C1: Ceramic capacitor with a capacitance of 0.1 uF
- C2: Capacitor value should be no more that 6.5 uF since that is the maximum capacitance allowed by the USB OTG spec for a dual-role device. The minimum value of C2 is 1 uF. There are no restrictions on the type of capacitor for C2.

If the VBUS charge pump circuit is not to be used, CSWITCHA, CSWITCHB, and OTGVBUS can be left unconnected.

4.9.1 Charge Pump Features

- Meets OTG Supplement Requirements, see the DC Characteristics: Charge Pump *Table 13-2*.

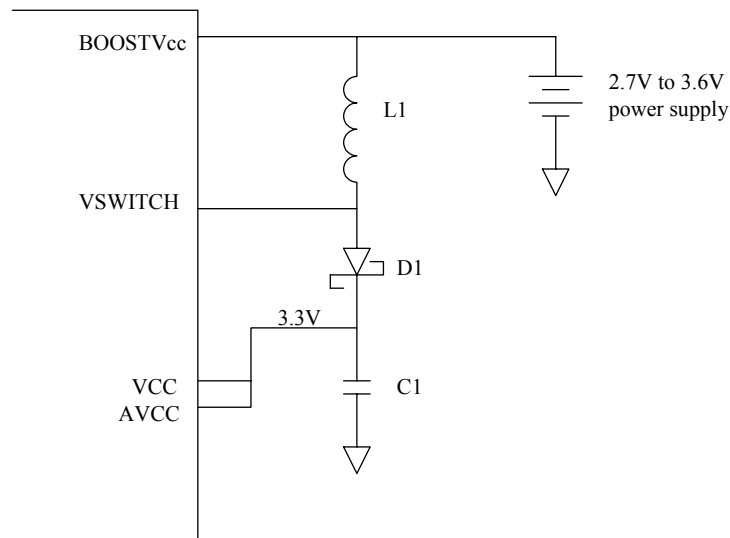
4.9.2 Charge Pump Pins

Table 4-11. Charge Pump Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| OTGVBUS | C1 |
| CSwitchA | D1 |
| CSwitchB | D2 |

4.10 Booster Interface

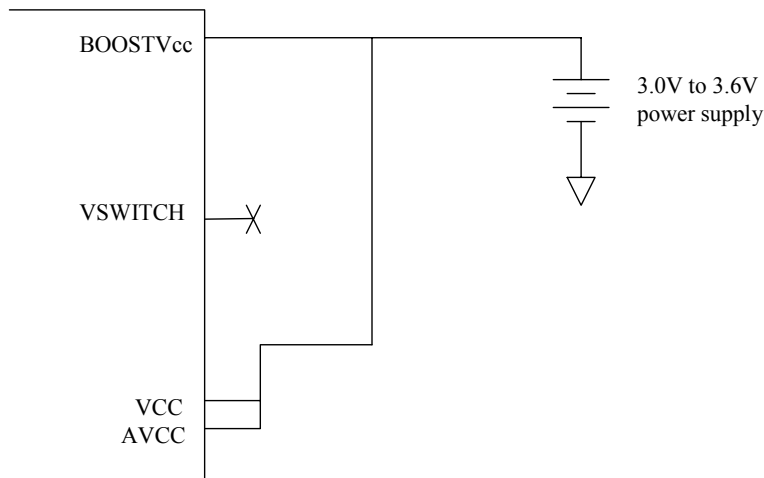
EZ-OTG has an on-chip power booster circuit for use with power supplies that range between 2.7V and 3.6V. The booster circuit boosts the power to 3.3V nominal to supply power for the entire chip. The booster circuit requires an external inductor, diode, and capacitor. During power down mode, the circuit is disabled to save power. *Figure 4-2* shows how to connect the booster circuit.


Figure 4-2. Power Supply Connection With Booster

Component details:

- L1: Inductor with inductance of 10 μ H and a current rating of at least 250 mA
- D1: Schottky diode with a current rating of at least 250 mA
- C1: Tantalum or ceramic capacitor with a capacitance of at least 2.2 μ F.

Figure 4-3 shows how to connect the power supply when the booster circuit is not being used.


Figure 4-3. Power Supply Connection Without Booster

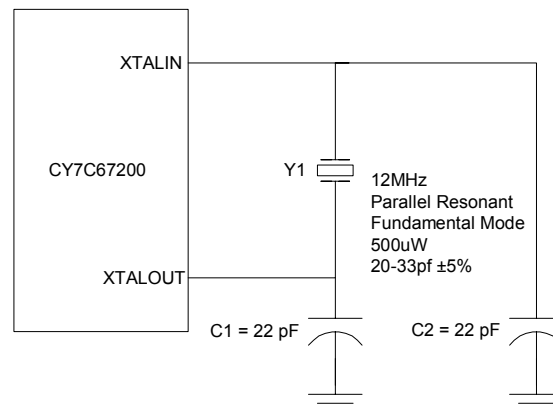
4.10.1 Booster Pins.

Table 4-12. Charge Pump Interface Pins

| Pin Name | Pin Number |
|----------|------------|
| BOOSTVcc | F1 |
| VSWITCH | E2 |

4.11 Crystal Interface

The recommended crystal circuit to be used with EZ-OTG is shown in *Figure 4-4*. If an oscillator is used instead of a crystal circuit, connect it to XTALIN and leave XTALOUT unconnected. For further information on the crystal requirements, see Crystal Requirements *Table 12-1*.


Figure 4-4. Crystal Interface

4.11.1 Crystal Pins.

Table 4-13. Crystal Pins

| Pin Name | Pin Number |
|----------|------------|
| XTALIN | G3 |
| XTALOUT | G2 |

4.12 Boot Configuration Interface

EZ-OTG can boot into any one of four modes. The mode it boots into is determined by the TTL voltage level of GPIO[31:30] at the time nRESET is deasserted. The table below shows the different boot pin combinations possible. After a reset pin event occurs, the BIOS bootup procedure executes for up to 3 ms. GPIO[31:30] are sampled by the BIOS during bootup only. After bootup these pins are available to the application as GPIOs.

Table 4-14. Boot Configuration Interface

| GPIO31 (Pin 39) | GPIO30 (Pin 40) | Boot Mode |
|-----------------|-----------------|---|
| 0 | 0 | Host Port Interface (HPI) |
| 0 | 1 | High Speed Serial (HSS) |
| 1 | 0 | Serial Peripheral Interface (SPI, slave mode) |
| 1 | 1 | I ² C EEPROM (Standalone Mode) |

GPIO[31:30] should be pulled high or low as needed using resistors tied to VCC or GND with resistor values between 5KΩ and 15KΩ. GPIO[31:30] should not be tied directly to VCC or GND. Note that in Standalone mode, the pull-ups on those two pins are used for the serial I²C EEPROM (if implemented). The resistors used for these pull-ups should conform to the serial EEPROM manufacturer's requirements.

If any mode other than standalone is chosen, EZ-OTG will be in coprocessor mode. The device will power up with the appropriate communication interface enabled according to its boot pins and wait idle until a coprocessor communicates with it. See the BIOS documentation for greater detail on the boot process.

4.13 Operational Modes

4.13.1 Coprocessor Mode

EZ-OTG can act as a coprocessor to an external host processor. In this mode, an external host processor drives EZ-OTG and is the main processor rather than EZ-OTG's own 16-bit internal CPU. An external host processor may interface to EZ-OTG through one of the following three interfaces in coprocessor mode:

- HPI mode, a 16-bit parallel interface with up to 16MBytes transfer rate
- HSS mode, a serial interface with up to 2 MBaud transfer rate
- SPI mode, a serial interface with up to 2 Mbits/s transfer rate.

At bootup GPIO[31:30] determine which of these three interfaces are used for coprocessor mode. Please refer to *Table 4-14* for details. Bootloading begins from the selected interface after POR + 3 ms of BIOS bootup.

4.13.2 Stand-alone Mode

In stand-alone mode, there is no external processor connected to EZ-OTG. Instead, EZ-OTG's own internal 16-bit CPU is the main processor and firmware is typically downloaded from an EEPROM. Optionally, firmware may also be downloaded via USB. Please refer to *Table 4-14* for booting into stand-alone mode.

After booting into stand-alone mode (GPIO[31:30] = '11'), the following pins are affected:

- GPIO[31:20] are configured as output pins to examine the EEPROM contents
- GPIO[28:27] are enabled for debug UART mode
- GPIO[29] is configured for as OTGID for OTG applications on PORT1A
 - If OTGID is logic 1 then PORT1A (OTG) is configured as a USB peripheral
 - If OTGID is logic 0 then PORT1A (OTG) is configured as a USB host
- Ports 1B, 2A, and 2B default as USB peripheral ports
- All other pins remain INPUT pins.

4.13.2.1 Minimum Hardware Requirements for Stand-alone Mode – Peripheral Only

Minimum Standalone Hardware Configuration - Peripheral Only

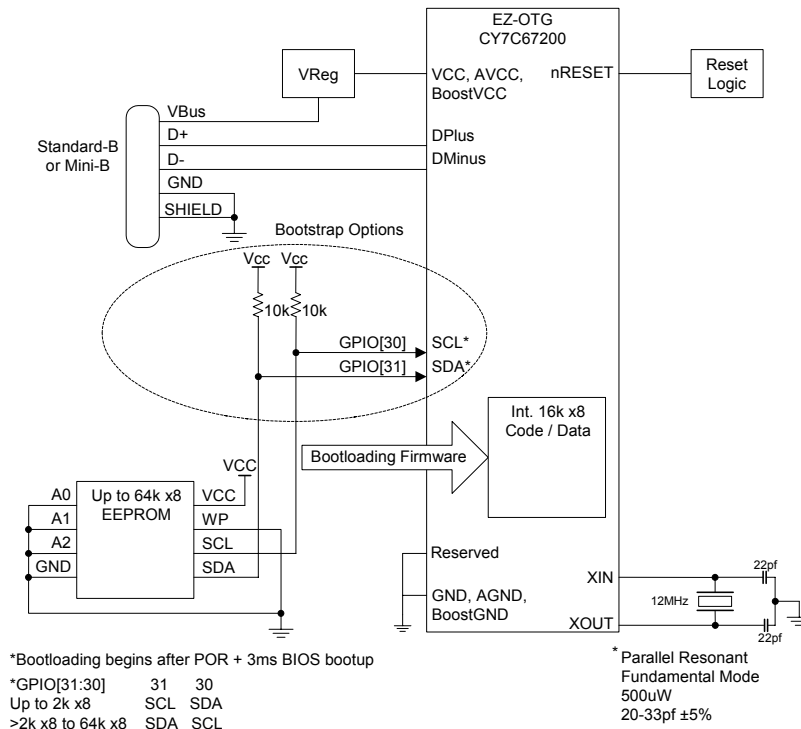


Figure 4-5. Minimum Standalone Hardware Configuration – Peripheral Only

5.0 Power Savings and Reset Description

5.1 Power Savings Mode Description

EZ-OTG has one main power savings mode, Sleep. For detailed information on Sleep mode please see section 5.2.

Sleep mode is used for USB applications to support USB suspend and non USB applications as the main chip power down mode.

In addition, EZ-OTG is capable of slowing down the CPU clock speed through the CPU Speed Register [0xC008] without affecting other peripheral timing. Reducing the CPU clock speed from 48 MHz to 24 MHz will reduce the overall current draw by around 8mA while reducing it from 48 MHz to 3 MHz will reduce the overall current draw by approximately 15 mA.

5.2 Sleep

Sleep mode is the main chip power down mode and is also used for USB suspend. Sleep mode is entered by setting the Sleep Enable (bit 1) of the Power Control Register [0xC00A]. During Sleep mode (USB Suspend) the following events and states are true:

- GPIO pins maintain their configuration during sleep (in suspend)
- External Memory Address pins are driven low
- XTALOUT will be turned off
- Internal PLL will be turned off
- Firmware should disable the charge pump (OTG Control Register [0xC098]) causing OTGVBUS to drop below 0.2V. Otherwise OTGVBUS will only drop to $V_{CC} - (2 \text{ schottky diode drops})$
- Booster circuit will be turned off
- USB transceivers will be turned off
- CPU will suspend until a programmable wakeup event.

5.3 External (Remote) wakeup Source

There are several possible events available to wake EZ-OTG from Sleep mode as shown in *Table 5-1*. These may also be used as remote wakeup options for USB applications. Please see the Power Down Control Register [0xC00A] for details.

Upon wakeup, code will begin executing within 200 ms, the time it takes the PLL to stabilize.

Table 5-1. wakeup Sources^[3, 4]

| wakeup Source (if enabled) | Event |
|----------------------------|-----------------|
| USB Resume | D+/D- Signaling |
| OTGVBUS | Level |
| OTGID | Any Edge |
| HPI | Read |
| HSS | Read |
| SPI | Read |
| IRQ0 (GPIO 24) | Any Edge |

5.4 Power-On Reset (POR) Description

The length of the power-on-reset event can be defined by (VCC ramp to valid) + (Crystal start up). A typical application might utilize a 12-ms power-on-reset event = ~7 ms + ~5 ms, respectively.

5.5 Reset Pin

The Reset pin is active low and requires a minimum pulse duration of 16 12-MHz clock cycles (1.3 ms). A reset event will restore all registers to their default POR settings. Code execution will then begin 200 ms later at 0xFF00 with an immediate jump to 0xE000, the start of BIOS.

It should be noted that for up to 3 ms after BIOS starts executing, GPIO[24:19] and GPIO[15:8] will be driven as outputs for a test mode. If these pins need to be used as inputs, a series resistor is required (10Ω-48Ω is recommended). Please refer to BIOS documentation for addition details.

5.6 USB Reset

A USB Reset will affect registers 0xC090 and 0xC0B0, all other registers remain unchanged.

6.0 Memory Map

6.1 Mapping

The EZ-OTG has just over 24 KB of addressable memory mapped from 0x0000 to 0xFFFF. This 24 KB contains both program and data space and is byte addressable. *Figure 6-1.* shows the various memory region address locations.

6.2 Internal Memory

Of the internal memory, 15 KB is allocated for user's program and data code. The lower memory space from 0x0000 to 0x04A2 is reserved for interrupt vectors, general purpose registers, USB control registers, the stack, and other BIOS variables. The upper internal memory space contains EZ-OTG control registers from 0xC000 to 0xC0FF and the BIOS ROM itself from 0xE000 to 0xFFFF. For more information on the reserved lower memory or the BIOS ROM, please refer to the Programmers documentation and the BIOS documentation.

During development with the EZ-OTG toolset, the lower area of User's space (0x04A4 to 0x1000) should be left available to load the GDB stub. The GDB stub is required to allow the toolset debug access into EZ-OTG.

Notes:

3. Read data will be discarded (dummy data).
4. HPI_INT will assert on a USB Resume.

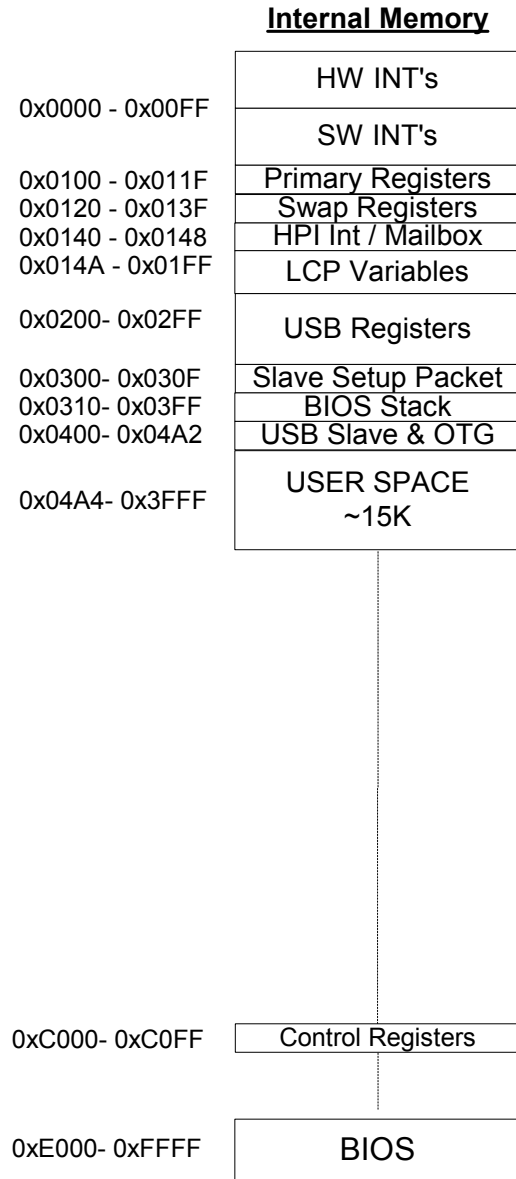


Figure 6-1. Memory Map

7.0 Registers

Some registers have different functions for a read vs. a write access or USB host vs. USB device mode. Therefore, registers of this type will have multiple definitions for the same address.

The default register values listed in this data sheet may get altered to some other value during BIOS initialization. Please refer to the BIOS documentation for Register initialization information.

7.1 Processor Control Registers

There are eight registers dedicated to general processor control. Each of these registers is covered in this section and is summarized in *Figure 7-1*.

| Register Name | Address | R/W |
|----------------------------|---------|-----|
| CPU Flags Register | 0xC000 | R |
| Register Bank Register | 0xC002 | R/W |
| Hardware Revision Register | 0xC004 | R |
| CPU Speed Register | 0xC008 | R/W |
| Power Control Register | 0xC00A | R/W |
| Interrupt Enable Register | 0xC00E | R/W |
| Breakpoint Register | 0xC014 | R/W |
| USB Diagnostic Register | 0xC03C | W |

Figure 7-1. Processor Control Registers

7.1.1 CPU Flags Register [0xC000] [R]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|-------------|----|----|----|----|----|---|---|
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|-------------|---|---|-------------------------|---------------|---------------|------------|-----------|
| Field | ...Reserved | | | Global Interrupt Enable | Negative Flag | Overflow Flag | Carry Flag | Zero Flag |
| Read/Write | - | - | - | R | R | R | R | R |
| Default | 0 | 0 | 0 | X | X | X | X | X |

Figure 7-2. CPU Flags Register

Register Description

The CPU Flags Register is a read-only register that gives processor flags status.

Global Interrupt Enable (Bit 4)

The Global Interrupt Enable bit indicates if the Global Interrupts are enabled.

1: Enabled

0: Disabled

Negative Flag (Bit 3)

The Negative Flag bit indicates if an arithmetic operation results in a negative answer.

1: MS result bit is '1'

0: MS result bit is not '1'

Overflow Flag (Bit 2)

The Overflow Flag bit indicates if an overflow condition has occurred. An overflow condition can occur if an arithmetic result was either larger than the destination operand size (for addition) or smaller than the destination operand should allow for subtraction.

1: Overflow occurred

0: Overflow did not occur

Carry Flag (Bit 1)

The Carry Flag bit indicates if an arithmetic operation resulted in a carry for addition, or borrow for subtraction.

1: Carry/Borrow occurred

0: Carry/Borrow did not occur

Zero Flag (Bit 0)

The Zero Flag bit indicates if an instruction execution resulted in a '0'.

1: Zero occurred

0: Zero did not occur

7.1.2 Bank Register [0xC002] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|----------|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | Reserved | | | | |
| Read/Write | R/W | R/W | R/W | - | - | - | - | - |
| Default | 0 | 0 | 0 | X | X | X | X | X |

Figure 7-3. Bank Register

Register Description

The Bank Register maps registers R0–R15 into RAM. The eleven MSBs of this register are used as a base address for registers R0–R15. A register address is automatically generated by:

- a. Shifting the four LSBs of the register address left by 1.
- b. ORing the four shifted bits of the register address with the 12 MSBs of the Bank Register.
- c. Force the LSB to zero.

For example, if the Bank Register is left at its default value of 0x0100, and R2 is read, then the physical address 0x0102 will be read. See *Table 7-1* for details.

Table 7-1. Bank Register Example

| Register | Hex Value | Binary Value |
|--------------|----------------------|---------------------|
| Bank | 0x0100 | 0000 0001 0000 0000 |
| R14 | 0x000E << 1 = 0x001C | 0000 0000 0001 1100 |
| RAM Location | 0x011C | 0000 0001 0001 1100 |

Address (Bits [15:4])

The Address field is used as a base address for all register addresses to start from.

Reserved

All reserved bits should be written as '0'.

7.1.3 Hardware Revision Register [0xC004] [R]

| | | | | | | | | |
|------------|-------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Revision... | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|-------------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Revision | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | X | X | X | X | X | X | X | X |

Figure 7-4. Revision Register
Register Description

The Hardware Revision Register is a read only register that indicates the silicon revision number. The first silicon revision is represented by 0x0101. This number will be increased by one for each new silicon revision.

Revision (Bits [15:0])

The Revision field contains the silicon revision number.

7.1.4 CPU Speed Register [0xC008] [R/W]

| | | | | | | | | |
|------------|-------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|---|---|---|-----------|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | | | | CPU Speed | | | |
| Read/Write | - | - | - | - | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

Figure 7-5. CPU Speed Register
Register Description

The CPU Speed Register allows the processor to operate at a user selected speed. This register will only affect the CPU, all other peripheral timing is still based on the 48-MHz system clock (unless otherwise noted).

CPU Speed (Bits[3:0])

The CPU Speed field is a divisor that selects the operating speed of the processor as defined in *Table 7-2*.

Table 7-2. CPU Speed Definition

| CPU Speed [3:0] | Processor Speed |
|-----------------|-----------------|
| 0000 | 48 MHz/1 |
| 0001 | 48 MHz/2 |
| 0010 | 48 MHz/3 |
| 0011 | 48 MHz/4 |
| 0100 | 48 MHz/5 |
| 0101 | 48 MHz/6 |
| 0110 | 48 MHz/7 |
| 0111 | 48 MHz/8 |
| 1000 | 48 MHz/9 |
| 1001 | 48 MHz/10 |
| 1010 | 48 MHz/11 |

Table 7-2. CPU Speed Definition (continued)

| CPU Speed [3:0] | Processor Speed |
|-----------------|-----------------|
| 1011 | 48 MHz/12 |
| 1100 | 48 MHz/13 |
| 1101 | 48 MHz/14 |
| 1110 | 48 MHz/15 |
| 1111 | 48 MHz/16 |

Reserved

All reserved bits should be written as '0'.

7.1.5 Power Control Register [0xC00A] [R/W]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|----------|---------------------------|----------|---------------------------|-----------------|----------|-----------------|-----------------|
| Field | Reserved | Host/Device 2 Wake Enable | Reserved | Host/Device 1 Wake Enable | OTG Wake Enable | Reserved | HSS Wake Enable | SPI Wake Enable |
| Read/Write | - | R/W | - | R/W | R/W | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|-----------------|----------|---|-----------------|----------|-------------|--------------|-------------|
| Field | HPI Wake Enable | Reserved | | GPI Wake Enable | Reserved | Boost 3V OK | Sleep Enable | Halt Enable |
| Read/Write | R/W | - | - | R/W | - | R | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-6. Power Control Register
Register Description

The Power Control Register controls the power-down and wakeup options. Either the sleep mode or the halt mode options can be selected. All other writable bits in this register can be used as a wakeup source while in sleep mode.

Host/Device 2 Wake Enable (Bit 14)

The Host/Device 2 Wake Enable bit enables or disables a wakeup condition to occur on an Host/Device 2 transition. This wake up from the SIE port does not cause an interrupt to the on-chip CPU.

1: Enable wakeup on Host/Device 2 transition.

0: Disable wakeup on Host/Device 2 transition.

Host/Device 1 Wake Enable (Bit 12)

The Host/Device 1 Wake Enable bit enables or disables a wakeup condition to occur on an Host/Device 1 transition. This wakeup from the SIE port does not cause an interrupt to the on-chip CPU.

1: Enable wakeup on Host/Device 1 transition

0: Disable wakeup on Host/Device 1 transition

OTG Wake Enable (Bit 11)

The OTG Wake Enable bit enables or disables a wakeup condition to occur on either an OTG VBUS_Valid or OTG ID transition (IRQ20).

1: Enable wakeup on OTG VBUS valid or OTG ID transition

0: Disable wakeup on OTG VBUS valid or OTG ID transition

HSS Wake Enable (Bit 9)

The HSS Wake Enable bit enables or disables a wakeup condition to occur on an HSS Rx serial input transition. The processor may take several hundreds of microseconds before being operational after wakeup. Therefore, the incoming data byte that causes the wakeup will be discarded.

1: Enable wakeup on HSS Rx serial input transition

0: Disable wakeup on HSS Rx serial input transition

SPI Wake Enable (Bit 8)

The SPI Wake Enable bit enables or disables a wakeup condition to occur on a falling SPI_nSS input transition. The processor may take several hundreds of microseconds before being operational after wakeup. Therefore, the incoming data byte that causes the wakeup will be discarded.

1: Enable wakeup on falling SPI nSS input transition

0: Disable SPI_nSS interrupt

HPI Wake Enable (Bit 7)

The HPI Wake Enable bit enables or disables a wakeup condition to occur on an HPI interface read.

1: Enable wakeup on HPI interface read

0: Disable wakeup on HPI interface read

GPI Wake Enable (Bit 4)

The GPI Wake Enable bit enables or disables a wakeup condition to occur on a GPIO(25:24) transition.

1: Enable wakeup on GPIO(25:24) transition

0: Disable wakeup on GPIO(25:24) transition

Boost 3V OK (Bit 2)

The Boost 3V OK bit is a read only bit that returns the status of the OTG Boost circuit.

1: Boost circuit not ok and internal voltage rails are below 3.0V

0: Boost circuit ok and internal voltage rails are at or above 3.0V

Sleep Enable (Bit 1)

Setting this bit to '1' will immediately initiate SLEEP mode. While in SLEEP mode, the entire chip is paused achieving the lowest standby power state. All operations are paused, the internal clock is stopped, the booster circuit and OTG VBUS charge pump are all powered down, and the USB transceivers are powered down. All counters and timers are paused but will retain their values. SLEEP mode exits by any activity selected in this register. When SLEEP mode ends, instruction execution will resume within 0.5 ms.

1: Enable Sleep Mode

0: No Function

Halt Enable (Bit 0)

Setting this bit to '1' will immediately initiate HALT mode. While in HALT mode, only the CPU is stopped. The internal clock still runs and all peripherals still operate, including the USB engines. The power savings using HALT in most cases will be minimal, but in applications that are very CPU intensive the incremental savings may provide some benefit.

The HALT state is exited when any enabled interrupt is triggered. Upon exiting the HALT state, one or two instructions immediately following the HALT instruction may get executed before the waking interrupt is serviced (you may want to follow the HALT instruction with two NOPs).

1: Enable Halt Mode

0: No Function

Reserved

All reserved bits should be written as '0'.

7.1.6 Interrupt Enable Register [0xC00E] [R/W]

| | | | | | | | | |
|------------|----------|----|----|----------------------|----------------------|----------|--------------------------------|--------------------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | OTG Interrupt Enable | SPI Interrupt Enable | Reserved | Host/Device 2 Interrupt Enable | Host/Device 1 Interrupt Enable |
| Read/Write | - | - | - | R/W | R/W | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|----------------------|-----------------------------|------------------------------|----------|-----------------------|-----------------------|--------------------------|--------------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | HSS Interrupt Enable | In Mailbox Interrupt Enable | Out Mailbox Interrupt Enable | Reserved | UART Interrupt Enable | GPIO Interrupt Enable | Timer 1 Interrupt Enable | Timer 0 Interrupt Enable |
| Read/Write | R/W | R/W | R/W | - | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

Figure 7-7. Interrupt Enable Register
Register Description

The Interrupt Enable Register allows control of the hardware interrupt vectors.

OTG Interrupt Enable (Bit 12)

The OTG Interrupt Enable bit enables or disables the OTG ID / OTG4.4V Valid hardware interrupt.

1: Enable OTG interrupt

0: Disable OTG interrupt

SPI Interrupt Enable (Bit 11)

The SPI Interrupt Enable bit enables or disables the following three SPI hardware interrupts: SPI TX, SPI RX, and SPI DMA Block Done.

1: Enable SPI interrupt

0: Disable SPI interrupt

Host/Device 2 Interrupt Enable (Bit 9)

The Host/Device 2 Interrupt Enable bit enables or disables all of the following Host/Device 2 hardware interrupts: Host 2 USB Done, Host 2 USB SOF/EOP, Host 2 WakeUp/Insert/Remove, Device 2 Reset, Device 2 SOF/EOP or WakeUp from USB, Device 2 Endpoint n.

1: Enable Host 2 and Device 2 interrupt

0: Disable Host 2 and Device 2 interrupt

Host/Device 1 Interrupt Enable (Bit 8)

The Host/Device 1 Interrupt Enable bit enables or disables all of the following Host/Device 1 hardware interrupts: Host 1 USB Done, Host 1 USB SOF/EOP, Host 1 WakeUp/Insert/Remove, Device 1 Reset, Device 1 SOF/EOP or WakeUp from USB, Device 1 Endpoint n.

1: Enable Host 2 and Device 2 interrupt

0: Disable Host 2 and Device 2 interrupt

HSS Interrupt Enable (Bit 7)

The HSS Interrupt Enable bit enables or disables the following High-speed Serial Interface hardware interrupts: HSS Block Done, and HSS RX Full.

1: Enable HSS interrupt

0: Disable HSS interrupt

In Mailbox Interrupt Enable (Bit 6)

The In Mailbox Interrupt Enable bit enables or disables the HPI: Incoming Mailbox hardware interrupt.

1: Enable MBXI interrupt

0: Disable MBXI interrupt

Out Mailbox Interrupt Enable (Bit 5)

The Out Mailbox Interrupt Enable bit enables or disables the HPI: Outgoing Mailbox hardware interrupt.

- 1: Enable MBXO interrupt
- 0: Disable MBXO interrupt

UART Interrupt Enable (Bit 3)

The UART Interrupt Enable bit enables or disables the following UART hardware interrupts: UART TX, and UART RX.

- 1: Enable UART interrupt
- 0: Disable UART interrupt

GPIO Interrupt Enable (Bit 2)

The GPIO Interrupt Enable bit enables or disables the General Purpose I/O Pins Interrupt (See the GPIO Control Register). When GPIO bit is reset, all pending GPIO interrupts are also cleared.

- 1: Enable GPIO interrupt
- 0: Disable GPIO interrupt

Timer 1 Interrupt Enable (Bit 1)

The Timer 1 Interrupt Enable bit enables or disables the TIme1 Interrupt Enable. When this bit is reset, all pending Timer 1 interrupts are cleared.

- 1: Enable TM1 interrupt
- 0: Disable TM1 interrupt

Timer 0 Interrupt Enable (Bit 0)

The Timer 0 Interrupt Enable bit enables or disables the TIme0 Interrupt Enable. When this bit is reset, all pending Timer 0 interrupts are cleared.

- 1: Enable TM0 interrupt
- 0: Disable TM0 interrupt

Reserved

All reserved bits should be written as '0'.

7.1.7 Breakpoint Register [0xC014] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-8. Breakpoint Register

Register Description

The Breakpoint Register holds the breakpoint address. When the program counter match this address, the INT127 interrupt occurs. To clear this interrupt, a zero value should be written to this register.

Address (Bits [15:0])

The Address field is a 16-bit field containing the breakpoint address.

7.1.8 USB Diagnostic Register [0xC03C] [R/W]

| | | | | | | | | |
|------------|----------|---------------------------|----------|---------------------------|-------------|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | Port 2A Diagnostic Enable | Reserved | Port 1A Diagnostic Enable | Reserved... | | | |
| Read/Write | - | R/W | - | R/W | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|------------------|-------------------|-------------------|----------|--------------|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | Pull-down Enable | LS Pull-up Enable | FS Pull-up Enable | Reserved | Force Select | | |
| Read/Write | - | R/W | R/W | R/W | - | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-9. USB Diagnostic Register
Register Description

The USB Diagnostic Register provides control of diagnostic modes. It is intended for use by device characterization tests, not for normal operations. This register is Read/Write by the on-chip CPU but is write only via the HPI port.

Port 2A Diagnostic Enable (Bit 15)

The Port 2A Diagnostic Enable bit enables or disables Port 2A for the test conditions selected in this register.

1: Apply any of the following enabled test conditions: J/K, DCK, SE0, RSF, RSL, PRD

0: Do not apply test conditions

Port 1A Diagnostic Enable (Bit 15)

The Port 1A Diagnostic Enable bit enables or disables Port 1A for the test conditions selected in this register.

1: Apply any of the following enabled test conditions: J/K, DCK, SE0, RSF, RSL, PRD

0: Do not apply test conditions

Pull-down Enable (Bit 6)

The Pull-down Enable bit enables or disables full-speed pull-down resistors (pull-down on both D+ and D-) for testing.

1: Enable pull-down resistors on both D+ and D-

0: Disable pull-down resistors on both D+ and D-

LS Pull-up Enable (Bit 5)

The LS Pull-up Enable bit enables or disables a low-speed pull-up resistor (pull-up on D-) for testing.

1: Enable low-speed pull-up resistor on D-

0: Pull-up resistor is not connected on D-

FS Pull-up Enable (Bit 4)

The FS Pull-up Enable bit enables or disables a full-speed pull-up resistor (pull-up on D+) for testing.

1: Enable full-speed pull-up resistor on D+

0: Pull-up resistor is not connected on D+

Force Select (Bits [2:0])

The Force Select field bit selects several different test condition states on the data lines (D+/D-). See *Table 7-3* for details.

Table 7-3. Force Select Definition

| Force Select [2:0] | Data Line State |
|--------------------|-----------------|
| 1xx | Assert SE0 |
| 01x | Toggle JK |
| 001 | Assert J |
| 000 | Assert K |

Reserved

All reserved bits should be written as '0'.

7.2 Timer Registers

There are three registers dedicated to timer operations. Each of these registers are discussed in this section and are summarized in *Figure 7-10*.

| Register Name | Address | R/W |
|-------------------------|---------|-----|
| Watchdog Timer Register | 0xC00C | R/W |
| Timer 0 Register | 0xC010 | R/W |
| Timer 1 Register | 0xC012 | R/W |

Figure 7-10. Timer Registers

7.2.1 Watchdog Timer Register [0xC00C] [R/W]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|-------------|-----|-----|-----|-----|-----|-----|-----|
| Field | Reserved... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|-------------|-----|--------------|---------------|-----|-------------|------------|--------------|
| Field | ...Reserved | | Timeout Flag | Period Select | | Lock Enable | WDT Enable | Reset Strobe |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-11. Watchdog Timer Register

Register Description

The Watchdog Timer Register provide status and control over the Watchdog timer. The Watchdog timer can also interrupt the processor.

Timeout Flag (Bit 5)

The Timeout Flag bit indicates if the Watchdog timer has expired. The processor can read this bit after exiting a reset to determine if a Watchdog time-out occurred. This bit will be cleared on the next external hardware reset.

1: Watchdog timer expired

0: Watchdog timer did not expire

Period Select (Bits [4:3])

The Period Select field is defined in *Table 7-4*. If this time expires before the Reset Strobe bit is set, the internal processor will get reset.

Table 7-4. Period Select Definition

| Period Select[4:3] | WDT Period Value |
|--------------------|------------------|
| 00 | 1.4 ms |
| 01 | 5.5 ms |
| 10 | 22.0 ms |
| 11 | 66.0 ms |

Lock Enable (Bit 2)

The Lock Enable bit will not allow any writes to this register until a reset. In doing so the Watchdog timer can be set up and enabled permanently so that it can only be cleared on reset (the WDT Enable bit is ignored).

1: Watchdog timer permanently set

0: Watchdog timer not permanently set

WDT Enable (Bit 1)

The WDT Enable bit enables or disables the Watchdog timer.

- 1: Enable Watchdog timer operation
- 0: Disable Watchdog timer operation

Reset Strobe (Bit 0)

The Reset Strobe is a write-only bit that resets the Watchdog timer count. It must be set to '1' before the count expires to avoid a Watchdog trigger

- 1: Reset Count

Reserved

All reserved bits should be written as '0'.

7.2.2 Timer n Register [R/W]

- Timer 0 Register 0xC010
- Timer 1 Register 0xC012

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Count... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Figure 7-12. Timer n Register

Register Description

The Timer n Register sets the Timer n count. Both Timer 0 and Timer 1 decrement by one every 1 μ s clock tick. Each can provide an interrupt to the CPU when the timer reaches zero.

Count (Bits [15:0])

The Count field sets the Timer count.

7.3 General USB Registers

There is one set of register dedicated to general USB control. This set consists of two identical registers, one for Host/Device Port 1 and one for Host/Device Port 2. This register set has functions for both USB host and USB peripheral options and is covered in this section and summarized in *Figure 7-13*. USB Host-only registers are covered in section 7.4 and USB Device-only registers are covered in section 7.5.

| Register Name | Address (SIE1/SIE2) | R/W |
|------------------------|---------------------|-----|
| USB n Control Register | 0xC08A / 0xC0AA | R/W |

Figure 7-13. USB Registers

7.3.1 USB n Control Register [R/W]

- USB 1 Control Register 0xC08A
- USB 2 Control Register 0xC0AA

| | | | | | | | | |
|------------|----------|----|------------------|------------------|----------|-----|-------------|----------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | Port A D+ Status | Port A D- Status | Reserved | LOA | Mode Select | Reserved |
| Read/Write | - | - | R | R | - | R/W | R/W | - |
| Default | X | X | X | X | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------------------|----------|---|-----------------------|-----|----------------|----------|-----------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Port A Resistors Enable | Reserved | | Port A Force D± State | | Suspend Enable | Reserved | Port A SOF/EOP Enable |
| Read/Write | R/W | - | - | R/W | R/W | R/W | - | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-14. USB n Control Register
Register Description

The USB n Control Register is used in both host and device mode. It monitors and controls the SIE and the data lines of the USB ports. This register can be accessed by the HPI interface.

Port A D+ Status (Bit 13)

The Port A D+ Status bit is a read-only bit that indicates the value of DATA+ on Port A.

1: D+ is high

0: D+ is low

Port A D- Status (Bit 12)

The Port A D- Status bit is a read-only bit that indicates the value of DATA- on Port A.

1: D- is high

0: D- is low

LOA (Bit 10)

The LOA bit selects the speed of Port A.

1: Port A is set to Low speed mode

0: Port A is set to Full speed mode

Mode Select (Bit 9)

The Mode Select bit sets the SIE for host or device operation. When set for device operation only one USB port is supported. The active port is selected by the Port Select bit in the Host n Count Register.

1: Host mode

0: Device mode

Port A Resistors Enable (Bit 7)

The Port A Resistors Enable bit enables or disables the pull-up/pull-down resistors on Port A. When enabled, the Mode Select bit and LOA bit of this Register will set the pull-up/pull-down resistors appropriately. When the Mode Select is set for Host mode, the pull-down resistors on the data lines (D+ and D-) are enabled. When the Mode Select is set for Device mode, a single pull-up resistor on either D+ or D-, determined by the LOA bit, will be enabled. Please see *Table 7-5* for details.

1: Enable pull-up/pull-down resistors

0: Disable pull-up/pull-down resistors

Table 7-5. USB Data Line Pull-Up and Pull-Down Resistors

| LOA | Mode Select | Port n Resistors Enable | Function |
|-----|-------------|-------------------------|---|
| X | X | 0 | Pull-up/Pull-down on D+ and D- Disabled |
| X | 1 | 1 | Pull-down on D+ and D- Enabled |
| 1 | 0 | 1 | Pull-up on USB D- Enabled |
| 0 | 0 | 1 | Pull-up on USB D+ Enabled |

Port A Force D± State (Bits [4:3])

The Port A Force D± State field controls the forcing state of the D+ D– data lines for Port A. This field will Force the state of the Port A data lines independent of the Port Select bit setting. See *Table 7-6* for details.

Table 7-6. Port A Force D± State

| Port A Force D± State | | Function |
|-----------------------|---|----------------------------|
| 0 | 0 | Normal Operation |
| 0 | 1 | Force USB Reset, SE0 State |
| 1 | 0 | Force J-State. |
| 1 | 1 | Force K-State. |

Suspend Enable (Bit 2)

The Suspend Enable bit enables or disables the suspend feature on both ports. When suspend is enabled the USB transceivers are powered down and can not transmit or received USB packets but can still monitor for a wakeup condition.

1: Enable suspend

0: Disable suspend

Port A SOF/EOP Enable (Bit 0)

The Port A SOF/EOP Enable bit is only applicable in host mode. In device mode this bit should be written as '0'. In host mode this bit enables or disables SOFs or EOPs for Port A. Either SOFs or EOPs will be generated depending on the LOA bit in the USB n Control Register when Port A is active.

1: Enable SOFs or EOPs

0: Disable SOFs or EOPs

Reserved

All reserved bits should be written as '0'.

7.4 USB Host Only Registers

There are twelve sets of dedicated registers to USB host only operation. Each set consists of two identical registers (unless otherwise noted), one for Host Port 1 and one for Host Port 2. These register sets are covered in this section and summarized in *Figure 7-15*.

| Register Name | Address (Host 1 / Host 2) | R/W |
|----------------------------------|---------------------------|-----|
| Host n Control Register | 0xC080 / 0xC0A0 | R/W |
| Host n Address Register | 0xC082 / 0xC0A2 | R/W |
| Host n Count Register | 0xC084 / 0xC0A4 | R/W |
| Host n Endpoint Status Register | 0xC086 / 0xC0A6 | R |
| Host n PID Register | 0xC086 / 0xC0A6 | W |
| Host n Count Result Register | 0xC088 / 0xC0A8 | R |
| Host n Device Address Register | 0xC088 / 0xC0A8 | W |
| Host n Interrupt Enable Register | 0xC08C / 0xC0AC | R/W |
| Host n Status Register | 0xC090 / 0xC0B0 | R/W |
| Host n SOF/EOP Count Register | 0xC092 / 0xC0B2 | R/W |
| Host n SOF/EOP Counter Register | 0xC094 / 0xC0B4 | R |
| Host n Frame Register | 0xC096 / 0xC0B6 | R |

Figure 7-15. USB Host Only Register

7.4.1 Host n Control Register [R/W]

- Host 1 Control Register 0xC080
- Host 2 Control Register 0xC0A0

| | | | | | | | | |
|------------|----------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-----------------|-----------------|-------------|------------|----------|---|---|------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Preamble Enable | Sequence Select | Sync Enable | ISO Enable | Reserved | | | Arm Enable |
| Read/Write | R/W | R/W | R/W | R/W | - | - | - | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-16. Host n Control Register
Register Description

The Host n Control Register allows high-level USB transaction control.

Preamble Enable (Bit 7)

The Preamble Enable bit enables or disables the transmission of a preamble packet before all low-speed packets. This bit should only be set when communicating with a low-speed device.

1: Enable Preamble packet

0: Disable Preamble packet

Sequence Select (Bit 6)

The Sequence Select bit sets the data toggle for the next packet. This bit has no effect on receiving data packets; sequence checking must be handled in firmware.

1: Send DATA1

0: Send DATA0

Sync Enable (Bit 5)

The Sync Enable bit will synchronize the transfer with the SOF packet in full-speed mode and the EOP packet in low-speed mode.

1: The next enabled packet will be transferred after the SOF or EOP packet is transmitted

0: The next enabled packet will be transferred as soon as the SIE is free

ISO Enable (Bit 4)

The ISO Enable bit enables or disables an Isochronous transaction.

1: Enable Isochronous transaction

0: Disable Isochronous transaction

Arm Enable (Bit 0)

The Arm Enable bit arms an endpoint and starts a transaction. This bit is automatically cleared to '0' when a transaction is complete.

1: Arm endpoint and begin transaction

0: Endpoint disarmed

Reserved

All reserved bits should be written as '0'.

7.4.2 Host n Address Register [R/W]

- Host 1 Address Register 0xC082
- Host 2 Address Register 0xC0A2

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-17. Host n Address Register
Register Description

The Host n Address Register is used as the base pointer into memory space for the current host transactions.

Address (Bits [15:0])

The Address field sets the address pointer into internal RAM or ROM.

7.4.3 Host n Count Register [R/W]

- Host 1 Count Register 0xC084
- Host 2 Count Register 0xC0A4

| | | | | | | | | |
|------------|----------|----|----|----|----|----|----------|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | Count... | |
| Read/Write | - | - | - | - | - | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-18. Host n Count Register
Register Description

The Host n Count Register is used to hold the number of bytes (packet length) for the current transaction. The maximum packet length is 1023 bytes in ISO mode. The Host Count value is used to determine how many bytes to transmit, or the maximum number of bytes to receive. If the number of received bytes is greater than the Host Count value then an overflow condition will be flagged by the Overflow bit in the Host n Endpoint Status Register.

Count (Bits [9:0])

The Count field sets the value for the current transaction data packet length. This value is retained when switching between host and device mode, and back again.

Reserved

All reserved bits should be written as '0'.

7.4.4 Host n Endpoint Status Register [R]

- Host 1 Endpoint Status Register 0xC086
- Host 2 Endpoint Status Register 0xC0A6

| | | | | | | | | |
|------------|----------|----|----|----|---------------|----------------|----------|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | Overflow Flag | Underflow Flag | Reserved | |
| Read/Write | - | - | - | - | R | R | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|----------|-----------------------|----------|-----------------|--------------|------------|----------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Stall Flag | NAK Flag | Length Exception Flag | Reserved | Sequence Status | Timeout Flag | Error Flag | ACK Flag |
| Read/Write | R | R | R | - | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-19. Host n Endpoint Status Register

Register Description

The Host n Endpoint Status Register is a read only register that provides status for the last USB transaction.

Overflow Flag (Bit 11)

The Overflow Flag bit indicates that the received data in the last data transaction exceeded the maximum length specified in the Host n Count Register. The Overflow Flag should be checked in response to a Length Exception signified by the Length Exception Flag set to '1'.

- 1: Overflow condition occurred
- 0: Overflow condition did not occur

Underflow Flag (Bit 10)

The Underflow Flag bit indicates that the received data in the last data transaction was less then the maximum length specified in the Host n Count Register. The Underflow Flag should be checked in response to a Length Exception signified by the Length Exception Flag set to '1'.

- 1: Underflow condition occurred
- 0: Underflow condition did not occur

Stall Flag (Bit 7)

The Stall Flag bit indicates that the peripheral device replied with a Stall in the last transaction.

- 1: Device returned Stall
- 0: Device did not return Stall

NAK Flag (Bit 6)

The NAK Flag bit indicates that the peripheral device replied with a NAK in the last transaction.

- 1: Device returned NAK
- 0: Device did not return NAK

Length Exception Flag (Bit 5)

The Length Exception Flag bit indicates the received data in the data stage of the last transaction does not equal the maximum Host Count specified in the Host n Count Register. A Length Exception can either mean an overflow or underflow and the Overflow and Underflow flags (bits 11 and 10, respectively) should be checked to determine which event occurred.

- 1: An overflow or underflow condition occurred
- 0: An overflow or underflow condition did not occur

Sequence Status (Bit 3)

The Sequence Status bit indicates the state of the last received data toggle from the device. Firmware is responsible for monitoring and handling the sequence status. The Sequence bit is only valid if the ACK bit is set to '1'. The Sequence bit is set to '0' when an error is detected in the transaction and the Error bit will be set.

- 1: DATA1
- 0: DATA0

Timeout Flag (Bit 2)

The Timeout Flag bit indicates if a timeout condition occurred for the last transaction. A timeout condition can occur when a device either takes too long to respond to a USB host request or takes too long to respond with a handshake.

- 1: Timeout occurred
- 0: Timeout did not occur

Error Flag (Bit 1)

The Error Flag bit indicates a transaction failed for any reason other than the following: Timeout, receiving a NAK, or receiving a STALL. Overflow and Underflow are not considered errors and do not affect this bit. CRC5 and CRC16 errors will result in an Error flag along with receiving incorrect packet types.

- 1: Error detected
- 0: No error detected

ACK Flag (Bit 0)

The ACK Flag bit indicates two different conditions depending on the transfer type. For non-Isochronous transfers, this bit represents a transaction ending by receiving or sending an ACK packet. For Isochronous transfers, this bit represents a successful transaction that will not be represented by an ACK packet.

- 1: For non-Isochronous transfers, the transaction was ACKed. For Isochronous transfers, the transaction was completed successfully.
- 0: For non-Isochronous transfers, the transaction was not ACKed. For Isochronous transfers, the transaction did not completed successfully.

7.4.5 Host n PID Register [W]

- Host 1 PID Register 0xC086
- Host 2 PID Register 0xC0A6

| | | | | | | | | |
|------------|------------|----|----|----|-----------------|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | PID Select | | | | Endpoint Select | | | |
| Read/Write | W | W | W | W | W | W | W | W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-20. Host n PID Register
Register Description

The Host n PID Register is a write-only register that provides the PID and Endpoint information to the USB SIE to be used in the next transaction.

PID Select (Bits [7:4])

The PID Select field defined as in *Table 7-7*. ACK and NAK tokens are automatically sent based on settings in the Host n Control Register and do not need to be written in this register.

Table 7-7. PID Select Definition

| PID TYPE | PID Select [7:4] |
|----------|------------------|
| set-up | 1101 (D Hex) |
| IN | 1001 (9 Hex) |
| OUT | 0001 (1 Hex) |
| SOF | 0101 (5 Hex) |
| PREAMBLE | 1100 (C Hex) |
| NAK | 1010 (A Hex) |
| STALL | 1110 (E Hex) |
| DATA0 | 0011 (3 Hex) |
| DATA1 | 1011 (B Hex) |

Endpoint Select (Bits [3:0])

The Endpoint field which allows addressing up to 16 different endpoints.

Reserved

All reserved bits should be written as '0'.

7.4.6 Host n Count Result Register [R]

- Host 1 Count Result Register 0xC088
- Host 2 Count Result Register 0xC0A8

| | | | | | | | | |
|------------|-----------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Result... | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-----------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Result | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-21. Host n Count Result Register

Register Description

The Host n Count Result Register is a read-only register that contains the size difference in bytes between the Host Count Value specified in the Host n Count Register and the last packet received. If an overflow or underflow condition occurs, i.e., the received packet length differs from the value specified in the Host n Count Register, the Length Exception Flag bit in the Host n Endpoint Status Register will be set. The value in this register is only valid when the Length Exception Flag bit is set and the Error Flag bit is not set; both bits are in the Host n Endpoint Status Register.

Result (Bits [15:0])

The Result field will contain the differences in bytes between the received packet and the value specified in the Host n Count Register. If an overflow condition occurs, Result [15:10] will be set to '111111', a 2's complement value indicating the additional byte count of the received packet. If an underflow condition occurs, Result [15:0] will indicate the excess bytes count (number of bytes not used).

Reserved

All reserved bits should be written as '0'.

7.4.7 Host n Device Address Register [W]

- Host 1 Device Address Register 0xC088
- Host 2 Device Address Register 0xC0A8

| | | | | | | | | |
|------------|-------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|---------|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | Address | | | | | | |
| Read/Write | - | W | W | W | W | W | W | W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-22. Host n Device Address Register

Register Description

The Host n Device Address Register is a write-only register that contains the USB Device Address that the host wishes to communicate with.

Address (Bits [6:0])

The Address field contains the value of the USB address for the next device that the host is going to communicate with. This value needs to be written by firmware.

Reserved

All reserved bits should be written as '0'.

7.4.8 Host n Interrupt Enable Register [R/W]

- Host 1 Interrupt Enable Register 0xC08C
- Host 2 Interrupt Enable Register 0xC0AC

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|-----------------------|---------------------|----------|----|----|----|--------------------------|----------|
| Field | VBUS Interrupt Enable | ID Interrupt Enable | Reserved | | | | SOF/EOP Interrupt Enable | Reserved |
| Read/Write | R/W | R/W | - | - | - | - | R/W | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|----------|------------------------------|----------|--|----------|---|---|-----------------------|
| Field | Reserved | Port A Wake Interrupt Enable | Reserved | Port A Connect Change Interrupt Enable | Reserved | | | Done Interrupt Enable |
| Read/Write | - | R/W | - | R/W | - | - | - | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-23. Host n Interrupt Enable Register

Register Description

The Host n Interrupt Enable Register will allow control over host-related interrupts.

In this register a bit set to '1' enables the corresponding interrupt while '0' disables the interrupt.

VBUS Interrupt Enable (Bit 15)

The VBUS Interrupt Enable bit will enable or disable the OTG VBUS interrupt. When enabled this interrupt will trigger on both rising and falling edge of VBUS at the 4.4V status (only supported in Port 1A). This bit is only available for Host 1 and is a reserved bit in Host 2.

1: Enable VBUS interrupt

0: Disable VBUS interrupt

ID Interrupt Enable (Bit 14)

The ID Interrupt Enable bit will enable or disable the OTG ID interrupt. When enabled this interrupt will trigger on both rising and falling edge of OTG ID pin (only supported in Port 1A). This bit is only available for Host 1 and is a reserved bit in Host 2.

1: Enable ID interrupt

0: Disable ID interrupt

SOF/EOP Interrupt Enable (Bit 9)

The SOF/EOP Interrupt Enable bit will enable or disable the SOF/EOP timer interrupt.

1: Enable SOF/EOP timer interrupt

0: Disable SOF/EOP timer interrupt

Port A Wake Interrupt Enable (Bit 6)

The Port A Wake Interrupt Enable bit will enable or disable the remote wakeup interrupt for Port A.

1: Enable remote wakeup interrupt for Port A

0: Disable remote wakeup interrupt for Port A

Port A Connect Change Interrupt Enable (Bit 4)

The Port A Connect Change Interrupt Enable bit will enable or disable the Connect Change interrupt on Port A. This interrupt will trigger when either a device is inserted (SE0 state to J state) or a device is removed (J state to SE0 state).

- 1: Enable Connect Change interrupt
- 0: Disable Connect Change interrupt

Done Interrupt Enable (Bit 0)

The Done Interrupt Enable bit enables or disables the USB Transfer Done interrupt. The USB Transfer Done will trigger when either the host responding with an ACK, or a device responds with any of the following: ACK, NAK, STALL, or Timeout. This interrupt is used for both Port A and Port B.

- 1: Enable USB Transfer Done interrupt
- 0: Disable USB Transfer Done interrupt

Reserved

All reserved bits should be written as '0'.

7.4.9 Host n Status Register [R/W]

- Host 1 Status Register 0xC090
- Host 2 Status Register 0xC0B0

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|---------------------|-------------------|----------|----|----|----|------------------------|----------|
| Field | VBUS Interrupt Flag | ID Interrupt Flag | Reserved | | | | SOF/EOP Interrupt Flag | Reserved |
| Read/Write | R/W | R/W | - | - | - | - | R/W | - |
| Default | X | X | X | X | X | X | X | X |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|----------|----------------------------|----------|--------------------------------------|----------|-------------------|----------|---------------------|
| Field | Reserved | Port A Wake Interrupt Flag | Reserved | Port A Connect Change Interrupt Flag | Reserved | Port A SE0 Status | Reserved | Done Interrupt Flag |
| Read/Write | - | R/W | - | R/W | - | R/W | - | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-24. Host n Status Register

Register Description

The Host n Status Register will provide status information for host operation. Pending interrupts can be cleared by writing a '1' to the corresponding bit. This register can be accessed by the HPI interface.

VBUS Interrupt Flag (Bit 15)

The VBUS Interrupt Flag bit indicates the status of the OTG VBUS interrupt (only for Port 1A). When enabled this interrupt will trigger on both the rising and falling edge of VBUS at 4.4V. This bit is only available for Host 1 and is a reserved bit in Host 2.

- 1: Interrupt triggered
- 0: Interrupt did not trigger

ID Interrupt Flag (Bit 14)

The ID Interrupt Flag bit indicates the status of the OTG ID interrupt (only for Port 1A). When enabled this interrupt will trigger on both the rising and falling edge of the OTG ID pin. This bit is only available for Host 1 and is a reserved bit in Host 2.

- 1: Interrupt triggered
- 0: Interrupt did not trigger

SOF/EOP Interrupt Flag (Bit 9)

The SOF/EOP Interrupt Flag bit indicates the status of the SOF/EOP Timer interrupt. This bit will trigger '1' when the SOF/EOP timer expires.

- 1: Interrupt triggered
- 0: Interrupt did not trigger

Port A Wake Interrupt Flag (Bit 6)

The Port A Wake Interrupt Flag bit indicates remote wakeup on PortA

1: Interrupt triggered

0: Interrupt did not trigger

Port A Connect Change Interrupt Flag (Bit 4)

The Port A Connect Change Interrupt Flag bit indicates the status of the Connect Change interrupt on Port A. This bit will trigger '1' on either a rising edge or falling edge of a USB Reset condition (device inserted or removed). Together with the Port A SE0 Status bit, it can be determined whether a device was inserted or removed.

1: Interrupt triggered

0: Interrupt did not trigger

Port A SE0 Status (Bit 2)

The Port A SE0 Status bit indicates if Port A is in an SE0 state or not. Together with the Port A Connect change Interrupt Flag bit, it can be determined whether a device was inserted (non-SE0 condition) or removed (SE0 condition).

1: SE0 condition

0: Non-SE0 condition

Done Interrupt Flag (Bit 0)

The Done Interrupt Flag bit indicates the status of the USB Transfer Done interrupt. The USB Transfer Done will trigger when either the host responding with and ACK, or a device responds with any of the following: ACK, NAK, STALL, or Timeout. This interrupt is used for both Port A and Port B.

1: Interrupt triggered

0: Interrupt did not trigger

7.4.10 Host n SOF/EOP Count Register [R/W]

- Host 1 SOF/EOP Count Register 0xC092
- Host 2 SOF/EOP Count Register 0xC0B2

| | | | | | | | | |
|------------|----------|----|----------|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | Count... | | | | | |
| Read/Write | - | - | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

Figure 7-25. Host n SOF/EOP Count Register

Register Description

The Host n SOF/EOP Count Register contains the SOF/EOP Count Value that is loaded into the SOF/EOP counter. This value is loaded each time the SOF/EOP counter counts down to zero. The default value set in this register at power-up is 0x2EE0, which will generate a 1-ms time frame. The SOF/EOP counter is a down counter decremented at a 12-MHz rate. When this register is read, the value returned is the programmed SOF/EOP count value.

Count (Bits [13:0])

The Count field sets the SOF/EOP counter duration.

Reserved

All reserved bits should be written as '0'.

7.4.11 Host n SOF/EOP Counter Register [R]

- Host 1 SOF/EOP Counter Register 0xC094
- Host 2 SOF/EOP Counter Register 0xC0B4

| | | | | | | | | |
|------------|----------|----|----|------------|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | Counter... | | | | |
| Read/Write | - | - | R | R | R | R | R | R |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|------------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Counter | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | X | X | X | X | X | X | X | X |

Figure 7-26. Host n SOF/EOP Counter Register
Register Description

The Host n SOF/EOP Counter Register contains the current value of the SOF/EOP down counter. This value can be used to determine the time remaining in the current frame.

Counter (Bits [13:0])

The Counter field contains the current value of the SOF/EOP down counter.

7.4.12 Host n Frame Register [R]

- Host 1 Frame Register 0xC096
- Host 2 Frame Register 0xC0B6

| | | | | | | | | |
|------------|----------|----|----|----|----|----------|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | Frame... | | |
| Read/Write | - | - | - | - | - | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|----------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Frame | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-27. Host n Frame Register
Register Description

The Host n Frame Register maintains the next frame number to be transmitted (current frame number + 1). This value is updated after each SOF transmission. This register resets to 0x0000 after each CPU write to the Host n SOF/EOP Count Register (Host 1: 0xC092, Host 2: 0xC0B2).

Frame (Bits [10:0])

The Frame field contains the next frame number to be transmitted.

Reserved

All reserved bits should be written as '0'.

7.5 USB Device Only Registers

There are ten sets of USB Device only registers. All sets consist of at least two registers, one for Device Port 1 and one for Device Port 2. In addition, each Device port has eight possible endpoints. This gives each endpoint register set eight registers for each Device Port for a total of 16 registers per set. The USB Device only registers are covered in this section and summarized in *Figure 7-28*.

| Register Name | Address (Device 1/Device 2) | R/W |
|--------------------------------------|-----------------------------|-----|
| Device n Endpoint n Control Register | 0x02n0 | R/W |
| Device n Endpoint n Address Register | 0x02n2 | R/W |
| Device n Endpoint n Count Register | 0x02n4 | R/W |

Figure 7-28. USB Device Only Registers

| Register Name | Address (Device 1/Device 2) | R/W |
|---|-----------------------------|-----|
| Device n Endpoint n Status Register | 0x02n6 | R/W |
| Device n Endpoint n Count Result Register | 0x02n8 | R/W |
| Device n Interrupt Enable Register | 0xC08C / 0xC0AC | R/W |
| Device n Address Register | 0xC08E / 0xC0AE | R/W |
| Device n Status Register | 0xC090 / 0xCB0 | R/W |
| Device n Frame Number Register | 0xC092 / 0xC0B2 | R |
| Device n SOF/EOP Count Register | 0xC094 / 0xC0B4 | W |

Figure 7-28. USB Device Only Registers (continued)
7.5.1 Device n Endpoint n Control Register [R/W]

- Device n Endpoint 0 Control Register [Device 1: 0x0200 Device 2: 0x0280]
- Device n Endpoint 1 Control Register [Device 1: 0x0210 Device 2: 0x0290]
- Device n Endpoint 2 Control Register [Device 1: 0x0220 Device 2: 0x02A0]
- Device n Endpoint 3 Control Register [Device 1: 0x0230 Device 2: 0x02B0]
- Device n Endpoint 4 Control Register [Device 1: 0x0240 Device 2: 0x02C0]
- Device n Endpoint 5 Control Register [Device 1: 0x0250 Device 2: 0x02D0]
- Device n Endpoint 6 Control Register [Device 1: 0x0260 Device 2: 0x02E0]
- Device n Endpoint 7 Control Register [Device 1: 0x0270 Device 2: 0x02F0]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|----------|----|----|----|----|----|---|---|
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | X | X | X | X | X | X | X | X |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|----------------------|-----------------|--------------|------------|----------------------|------------------|--------|------------|
| Field | IN/OUT Ignore Enable | Sequence Select | Stall Enable | ISO Enable | NAK Interrupt Enable | Direction Select | Enable | Arm Enable |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-29. Device n Endpoint n Control Register
Register Description

The Device n Endpoint n Control Register provides control over a single EP in device mode. There are a total of eight endpoints for each of the two ports. All endpoints have the same definition for their Device n Endpoint n Control Register.

IN/OUT Ignore Enable (Bit 6)

The IN/OUT Ignore Enable bit will force endpoint 0 (EP0) to ignore all IN and OUT requests. This bit should be set so that EP0 only accepts Set-up packets at the start of each transfer. This bit must be cleared to accept IN/OUT transactions. This bit only applies to EP0.

1: Ignore IN/OUT requests

0: Do not ignore IN/OUT requests

Sequence Select (Bit 6)

The Sequence Select bit will determine whether a DATA0 or a DATA1 will be sent for the next data toggle. This bit has no effect on receiving data packets, sequence checking must be handled in firmware.

1: Send a DATA1

0: Send a DATA0

Stall Enable (Bit 5)

The Stall Enable bit will send a Stall in response to the next request (unless it is a set-up request, which are always ACKed). This is a sticky bit and will continue to respond with Stalls until cleared by firmware.

1: Send Stall

0: Do not send Stall

ISO Enable (Bit 4)

The ISO Enable bit enables and disables an Isochronous transaction. This bit is only valid for EPs 1–7 and has no function for EP0.

- 1: Enable Isochronous transaction
- 0: Disable Isochronous transaction

NAK Interrupt Enable (Bit 3)

The NAK Interrupt Enable bit enables and disables the generation of an Endpoint n interrupt when the device responds to the host with a NAK. The Endpoint n Interrupt Enable bit in the Device n Interrupt Enable Register must also be set. When a NAK is sent to the host, the corresponding EP Interrupt Flag in the Device n Status Register will be set. In addition, the NAK Flag in the Device n Endpoint n Status Register will be set.

- 1: Enable NAK interrupt
- 0: Disable NAK interrupt

Direction Select (Bit 2)

The Direction Select bit needs to be set according to the expected direction of the next data stage in the next transaction. If the data stage direction is different from what is set in this bit, it will get NAKed and either the IN Exception Flag or the OUT Exception Flag will be set in the Device n Endpoint n Status Register. If a set-up packet is received and the Direction Select bit is set incorrectly, the set-up will get ACKed and the Set-up Status Flag will be set (please refer to the set-up bit of the Device n Endpoint n Status Register for details).

- 1: OUT transfer (host to device)
- 0: IN transfer (device to host)

Enable (Bit 1)

The Enable bit must be set to allow transfers to the endpoint. If Enable is set to '0' then all USB traffic to this endpoint will be ignored. If Enable is set '1' and Arm Enable (bit 0) is set '0' then NAKs will automatically be returned from this endpoint (except set-up packets which are always ACKed as long as the Enable bit is set.)

- 1: Enable transfers to an endpoint
- 0: Do not allow transfers to an endpoint

Arm Enable (Bit 0)

The Arm Enable bit arms the endpoint to transfer or receive a packet. This bit is cleared to '0' when a transaction is complete.

- 1: Arm endpoint
- 0: Endpoint disarmed

Reserved

All reserved bits should be written as '0'.

7.5.2 Device n Endpoint n Address Register [R/W]

- Device n Endpoint 0 Address Register [Device 1: 0x0202 Device 2: 0x0282]
- Device n Endpoint 1 Address Register [Device 1: 0x0212 Device 2: 0x0292]
- Device n Endpoint 2 Address Register [Device 1: 0x0222 Device 2: 0x02A2]
- Device n Endpoint 3 Address Register [Device 1: 0x0232 Device 2: 0x02B2]
- Device n Endpoint 4 Address Register [Device 1: 0x0242 Device 2: 0x02C2]
- Device n Endpoint 5 Address Register [Device 1: 0x0252 Device 2: 0x02D2]
- Device n Endpoint 6 Address Register [Device 1: 0x0262 Device 2: 0x02E2]
- Device n Endpoint 7 Address Register [Device 1: 0x0272 Device 2: 0x02F2]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-30. Device n Endpoint n Address Register

Register Description

The Device n Endpoint n Address Register is used as the base pointer into memory space for the current Endpoint transaction. There are a total of eight endpoints for each of the two ports. All endpoints have the same definition for their Device n Endpoint n Address Register.

Address (Bits [15:0])

The Address field sets the base address for the current transaction on a signal endpoint.

7.5.3 Device n Endpoint n Count Register [R/W]

- Device n Endpoint 0 Count Register [Device 1: 0x0204 Device 2: 0x0284]
- Device n Endpoint 1 Count Register [Device 1: 0x0214 Device 2: 0x0294]
- Device n Endpoint 2 Count Register [Device 1: 0x0224 Device 2: 0x02A4]
- Device n Endpoint 3 Count Register [Device 1: 0x0234 Device 2: 0x02B4]
- Device n Endpoint 4 Count Register [Device 1: 0x0244 Device 2: 0x02C4]
- Device n Endpoint 5 Count Register [Device 1: 0x0254 Device 2: 0x02D4]
- Device n Endpoint 6 Count Register [Device 1: 0x0264 Device 2: 0x02E4]
- Device n Endpoint 7 Count Register [Device 1: 0x0274 Device 2: 0x02F4]

| | | | | | | | | |
|------------|----------|----|----|----|----|----|----------|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | Count... | |
| Read/Write | - | - | - | - | - | - | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-31. Device n Endpoint n Count Register

Register Description

The Device n Endpoint n Count Register designates the maximum packet size that can be received from the host for OUT transfers for a single endpoint. This register also designates the packet size to be sent to the host in response to the next IN token for a single endpoint. The maximum packet length is 1023 bytes in ISO mode. There are a total of eight endpoints for each of the two ports. All endpoints have the same definition for their Device n Endpoint n Count Register.

Count (Bits [9:0])

The Count field sets the current transaction packet length for a single endpoint.

Reserved

All reserved bits should be written as '0'.

7.5.4 Device n Endpoint n Status Register [R/W]

- Device n Endpoint 0 Status Register [Device 1: 0x0206 Device 2: 0x0286]
- Device n Endpoint 1 Status Register [Device 1: 0x0216 Device 2: 0x0296]
- Device n Endpoint 2 Status Register [Device 1: 0x0226 Device 2: 0x02A6]
- Device n Endpoint 3 Status Register [Device 1: 0x0236 Device 2: 0x02B6]
- Device n Endpoint 4 Status Register [Device 1: 0x0246 Device 2: 0x02C6]
- Device n Endpoint 5 Status Register [Device 1: 0x0256 Device 2: 0x02D6]
- Device n Endpoint 6 Status Register [Device 1: 0x0266 Device 2: 0x02E6]
- Device n Endpoint 7 Status Register [Device 1: 0x0276 Device 2: 0x02F6]

| | | | | | | | | |
|------------|----------|----|----|----|---------------|----------------|--------------------|-------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | Overflow Flag | Underflow Flag | OUT Exception Flag | IN Exception Flag |
| Read/Write | - | - | - | - | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|------------|----------|-----------------------|-------------|---------------|---------------|------------|----------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Stall Flag | NAK Flag | Length Exception Flag | Set-up Flag | Sequence Flag | Time-out Flag | Error Flag | ACK Flag |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-32. Device n Endpoint n Status Register

Register Description

The Device n Endpoint n Status Register provides packet status information for the last transaction received or transmitted. This register is updated in hardware and does not need to be cleared by firmware. There are a total of eight endpoints for each of the two ports. All endpoints have the same definition for their Device n Endpoint n Status Register.

The Device n Endpoint n Status Register is a memory-based register that should be initialized to 0x0000 before USB Device operations are initiated. After initialization, this register should not be written to again.

Overflow Flag (Bit 11)

The Overflow Flag bit indicates that the received data in the last data transaction exceeded the maximum length specified in the Device n Endpoint n Count Register. The Overflow Flag should be checked in response to a Length Exception signified by the Length Exception Flag set to '1'.

1: Overflow condition occurred

0: Overflow condition did not occur

Underflow Flag (Bit 10)

The Underflow Flag bit indicates that the received data in the last data transaction was less than the maximum length specified in the Device n Endpoint n Count Register. The Underflow Flag should be checked in response to a Length Exception signified by the Length Exception Flag set to '1'.

1: Underflow condition occurred

0: Underflow condition did not occur

OUT Exception Flag (Bit 9)

The OUT Exception Flag bit will indicate when the device received an OUT packet when armed for an IN.

1: Received OUT when armed for IN

0: Received IN when armed for IN

IN Exception Flag (Bit 8)

The IN Exception Flag bit will indicate when the device received an IN packet when armed for an OUT.

1: Received IN when armed for OUT

0: Received OUT when armed for OUT

Stall Flag (Bit 7)

The Stall Flag bit indicates that a Stall packet was sent to the host.

1: Stall packet was sent to the host

0: Stall packet was not sent

NAK Flag (Bit 6)

The NAK Flag bit indicates that a NAK packet was sent to the host.

1: NAK packet was sent to the host

0: NAK packet was not sent

Length Exception Flag (Bit 5)

The Length Exception Flag bit indicates the received data in the data stage of the last transaction does not equal the maximum Endpoint Count specified in the Device n Endpoint n Count Register. A Length Exception can either mean an overflow or underflow and the Overflow and Underflow flags (bits 11 and 10, respectively) should be checked to determine which event occurred.

- 1: An overflow or underflow condition occurred
- 0: An overflow or underflow condition did not occur

Set-up Flag (Bit 4)

The Set-up Flag bit indicates that a set-up packet was received. In device mode set-up packets get stored at memory location 0x0300 for Device 1 and 0x0308 for Device 2. Set-up packets are always accepted regardless of the Direction Select and Arm Enable bit settings as long as the Device n EP n Control Register Enable bit is set.

- 1: Set-up packet was received
- 0: Set-up packet was not received

Sequence Flag (Bit 3)

The Sequence Flag bit indicates whether the last data toggle received was a DATA1 or a DATA0. This bit has no effect on receiving data packets, sequence checking must be handled in firmware.

- 1: DATA1 was received
- 0: DATA0 was received

Time-out Flag (Bit 2)

The Time-out Flag bit indicates whether a time-out condition occurred on the last transaction. On the device side, a time-out can occur if the device sends a data packet in response to an IN request but then does not receive a handshake packet in a predetermined time. It can also occur if the device does not receive the data stage of an OUT transfer in time.

- 1: Time-out occurred
- 0: Time-out condition did not occur

Error Flag (Bit 2)

The Error Flag bit will be set if a CRC5 and CRC16 error occurs, or if an incorrect packet type is received. Overflow and Underflow are not considered errors and do not affect this bit.

- 1: Error occurred
- 0: Error did not occur

ACK Flag (Bit 0)

The ACK Flag bit indicates whether the last transaction was ACKed.

- 1: ACK occurred
- 0: ACK did not occur

7.5.5 Device n Endpoint n Count Result Register [R/W]

- Device n Endpoint 0 Count Result Register [Device 1: 0x0208 Device 2: 0x0288]
- Device n Endpoint 1 Count Result Register [Device 1: 0x0218 Device 2: 0x0298]
- Device n Endpoint 2 Count Result Register [Device 1: 0x0228 Device 2: 0x02A8]
- Device n Endpoint 3 Count Result Register [Device 1: 0x0238 Device 2: 0x02B8]
- Device n Endpoint 4 Count Result Register [Device 1: 0x0248 Device 2: 0x02C8]
- Device n Endpoint 5 Count Result Register [Device 1: 0x0258 Device 2: 0x02D8]
- Device n Endpoint 6 Count Result Register [Device 1: 0x0268 Device 2: 0x02E8]
- Device n Endpoint 7 Count Result Register [Device 1: 0x0278 Device 2: 0x02F8]

| | | | | | | | | |
|------------|-----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Result... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|-----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Result | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-33. Device n Endpoint n Count Result Register

Register Description

The Device n Endpoint n Count Result Register contains the size difference in bytes between the Endpoint Count specified in the Device n Endpoint n Count Register and the last packet received. If an overflow or underflow condition occurs, i.e. the received packet length differs from the value specified in the Device n Endpoint n Count Register, the Length Exception Flag bit in the Device n Endpoint n Status Register will be set. The value in this register is only valid when the Length Exception Flag bit is set and the Error Flag bit is not set, both bits are in the Device n Endpoint n Status Register.

The Device n Endpoint n Count Result Register is a memory based register that should be initialized to 0x0000 before USB Device operations are initiated. After initialization, this register should not be written to again.

Result (Bits [15:0])

The Result field will contain the differences in bytes between the received packet and the value specified in the Device n Endpoint n Count Register. If an overflow condition occurs, Result [15:10] will be set to '111111', a 2's complement value indicating the additional byte count of the received packet. If an underflow condition occurs, Result [15:0] will indicate the excess bytes count (number of bytes not used).

Reserved

All reserved bits should be written as '0'.

7.5.6 Device n Interrupt Enable Register [R/W]

- Device 1 Interrupt Enable Register 0xC08C
- Device 2 Interrupt Enable Register 0xC0AC

| | | | | | | | | |
|------------|-----------------------|---------------------|----------|----|-----------------------------------|----------|--------------------------|------------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | VBUS Interrupt Enable | ID Interrupt Enable | Reserved | | SOF/EOP Time-out Interrupt Enable | Reserved | SOF/EOP Interrupt Enable | Reset Interrupt Enable |
| Read/Write | R/W | R/W | - | - | R/W | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | EP7 Interrupt Enable | EP6 Interrupt Enable | EP5 Interrupt Enable | EP4 Interrupt Enable | EP3 Interrupt Enable | EP2 Interrupt Enable | EP1 Interrupt Enable | EP0 Interrupt Enable |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-34. Device n Interrupt Enable Register

Register Description

The Device n Interrupt Enable Register provides control over device related interrupts including eight different endpoint interrupts.

VBUS Interrupt Enable (Bit 15)

The VBUS Interrupt Enable bit will enable or disable the OTG VBUS interrupt. When enabled this interrupt will trigger on both rising and falling edge of VBUS at the 4.4V status (only supported in Port 1A). This bit is only available for Device 1 and is a reserved bit in Device 2.

1: Enable VBUS interrupt

0: Disable VBUS interrupt

ID Interrupt Enable (Bit 14)

The ID Interrupt Enable bit will enable or disable the OTG ID interrupt. When enabled this interrupt will trigger on both rising and falling edge of OTG ID pin (only supported in Port 1A). This bit is only available for Device 1 and is a reserved bit in Device 2.

- 1: Enable ID interrupt
- 0: Disable ID interrupt

SOF/EOP Time-out Interrupt Enable (Bit 11)

The SOF/EOP Time-out Interrupt Enable bit will enable or disable the SOF/EOP Time-out Interrupt. When enabled this interrupt will trigger when the USB host fails to send a SOF or EOP packet within the time period specified in the Device n SOF/EOP Count Register. In addition, the Device n Frame Register counts the number of times the SOF/EOP Timeout Interrupt triggers between receiving SOF/EOPs.

- 1: SOF/EOP time-out occurred
- 0: SOF/EOP time-out did not occur

SOF/EOP Interrupt Enable (Bit 9)

The SOF/EOP Interrupt Enable bit will enable or disable the SOF/EOP received interrupt.

- 1: Enable SOF/EOP Received interrupt
- 0: Disable SOF/EOP Received interrupt

Reset Interrupt Enable (Bit 8)

The Reset Interrupt Enable bit will enable or disable the USB Reset Detected interrupt

- 1: Enable USB Reset Detected interrupt
- 0: Disable USB Reset Detected interrupt

EP7 Interrupt Enable (Bit 7)

The EP7 Interrupt Enable bit will enable or disable endpoint seven (EP7) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP7 Transaction Done interrupt
- 0: Disable EP7 Transaction Done interrupt

EP6 Interrupt Enable (Bit 6)

The EP6 Interrupt Enable bit will enable or disable endpoint seven (EP6) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP6 Transaction Done interrupt
- 0: Disable EP6 Transaction Done interrupt

EP5 Interrupt Enable (Bit 5)

The EP5 Interrupt Enable bit will enable or disable endpoint seven (EP5) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP5 Transaction Done interrupt
- 0: Disable EP5 Transaction Done interrupt

EP4 Interrupt Enable (Bit 4)

The EP4 Interrupt Enable bit will enable or disable endpoint seven (EP4) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP4 Transaction Done interrupt
- 0: Disable EP4 Transaction Done interrupt

EP3 Interrupt Enable (Bit 3)

The EP3 Interrupt Enable bit will enable or disable endpoint seven (EP3) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP3 Transaction Done interrupt
- 0: Disable EP3 Transaction Done interrupt

EP2 Interrupt Enable (Bit 2)

The EP2 Interrupt Enable bit will enable or disable endpoint seven (EP2) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP2 Transaction Done interrupt
- 0: Disable EP2 Transaction Done interrupt

EP1 Interrupt Enable (Bit 1)

The EP1 Interrupt Enable bit will enable or disable endpoint seven (EP1) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP1 Transaction Done interrupt
- 0: Disable EP1 Transaction Done interrupt

EP0 Interrupt Enable (Bit 0)

The EP0 Interrupt Enable bit will enable or disable endpoint seven (EP0) Transaction Done interrupt. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the device's given Endpoint: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, the NAK Interrupt Enable bit in the Device n Endpoint Control Register can also be set so that NAK responses will trigger this interrupt.

- 1: Enable EP0 Transaction Done interrupt
- 0: Disable EP0 Transaction Done interrupt

Reserved

All reserved bits should be written as '0'.

7.5.7 Device n Address Register [W]

- Device 1 Address Register 0xC08E
- Device 2 Address Register 0xC0AE

| | | | | | | | | |
|------------|-------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|---------|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | Address | | | | | | |
| Read/Write | - | W | W | W | W | W | W | W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-35. Device n Address Register

Register Description

The Device n Address Register holds the device address assigned by the host. This register initializes to the default address 0 at reset but must be updated by firmware when the host assigns a new address. Only USB data sent to the address contained in this register will be responded to, all others are ignored.

Address (Bits [6:0])

The Address field contains the USB address of the device assigned by the host.

Reserved

All reserved bits should be written as '0'.

7.5.8 Device n Status Register [R/W]

- Device 1 Status Register 0xC090
- Device 2 Status Register 0xC0B0

| | | | | | | | | |
|------------|---------------------|-------------------|----------|----|----|----|------------------------|----------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | VBUS Interrupt Flag | ID Interrupt Flag | Reserved | | | | SOF/EOP Interrupt Flag | Reset Interrupt Flag |
| Read/Write | R/W | R/W | - | - | - | - | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | EP7 Interrupt Flag | EP6 Interrupt Flag | EP5 Interrupt Flag | EP4 Interrupt Flag | EP3 Interrupt Flag | EP2 Interrupt Flag | EP1 Interrupt Flag | EP0 Interrupt Flag |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-36. Device n Status Register

Register Description

The Device n Status Register provides status information for device operation. Pending interrupts can be cleared by writing a '1' to the corresponding bit. This register can be accessed by the HPI interface.

VBUS Interrupt Flag (Bit 15)

The VBUS Interrupt Flag bit indicates the status of the OTG VBUS interrupt (only for Port 1A). When enabled this interrupt will trigger on both the rising and falling edge of VBUS at 4.4V. This bit is only available for Device 1 and is a reserved bit in Device 2.

1: Interrupt triggered

0: Interrupt did not trigger

ID Interrupt Flag (Bit 14)

The ID Interrupt Flag bit indicates the status of the OTG ID interrupt (only for Port 1A). When enabled this interrupt will trigger on both the rising and falling edge of the OTG ID pin. This bit is only available for Device 1 and is a reserved bit in Device 2.

1: Interrupt triggered

0: Interrupt did not trigger

SOF/EOP Interrupt Flag (Bit 9)

The SOF/EOP Interrupt Flag bit indicates if the SOF/EOP received interrupt has triggered.

1: Interrupt triggered

0: Interrupt did not trigger

Reset Interrupt Flag (Bit 8)

The Reset Interrupt Flag bit indicates if the USB Reset Detected interrupt has triggered.

1: Interrupt triggered

0: Interrupt did not trigger

EP7 Interrupt Flag (Bit 7)

The EP7 Interrupt Flag bit indicates if the endpoint seven (EP7) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP6 Interrupt Flag (Bit 6)

The EP6 Interrupt Flag bit indicates if the endpoint six (EP6) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP5 Interrupt Flag (Bit 5)

The EP5 Interrupt Flag bit indicates if the endpoint five (EP5) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP4 Interrupt Flag (Bit 4)

The EP4 Interrupt Flag bit indicates if the endpoint four (EP4) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP3 Interrupt Flag (Bit 3)

The EP3 Interrupt Flag bit indicates if the endpoint three (EP3) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP2 Interrupt Flag (Bit 2)

The EP2 Interrupt Flag bit indicates if the endpoint two (EP2) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP1 Interrupt Flag (Bit 1)

The EP1 Interrupt Flag bit indicates if the endpoint one (EP1) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

EP0 Interrupt Flag (Bit 0)

The EP0 Interrupt Flag bit indicates if the endpoint zero (EP0) Transaction Done interrupt has triggered. An EPx Transaction Done interrupt will trigger when any of the following responses or events occur in a transaction for the devices given EP: send/receive ACK, send STALL, Time-out occurs, IN Exception Error, or OUT Exception Error. In addition, if the NAK Interrupt Enable bit in the Device n Endpoint Control Register is set, this interrupt will also trigger when the device NAKs host requests.

1: Interrupt triggered

0: Interrupt did not trigger

Reserved

All reserved bits should be written as '0'.

7.5.9 Device n Frame Number Register [R]

- Device 1 Frame Number Register 0xC092
- Device 2 Frame Number Register 0xC0B2

| | | | | | | | | |
|------------|-----------------------|------------------------------------|----|----|----------|----------|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | SOF/EOP Time-out Flag | SOF/EOP Time-out Interrupt Counter | | | Reserved | Frame... | | |
| Read/Write | R | R | R | R | - | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|----------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Frame | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-37. Device n Frame Number Register
Register Description

The Device n Frame Number Register is a read only register that contains the Frame number of the last SOF packet received. This register also contains a count of SOF/EOP Timeout occurrences.

SOF/EOP Time-out Flag (Bit 15)

The SOF/EOP Time-out Flag bit indicates when an SOF/EOP Timeout Interrupt occurs.

1: An SOF/EOP Time-out interrupt occurred

0: An SOF/EOP Time-out interrupt did not occur

SOF/EOP Time-out Interrupt Counter (Bits [14:12])

The SOF/EOP Time-out Interrupt Counter field will increment by 1 from 0 to 7 for each SOF/EOP Time-out Interrupt. This field resets to 0 when a SOF/EOP is received. This field is only updated when the SOF/EOP Time-out Interrupt Enable bit in the Device n Interrupt Enable Register is set.

Frame (Bits [10:0])

The Frame field contains the frame number from the last received SOF packet in full speed mode. This field has no function for low speed mode. If a SOF Timeout occurs, this field will contain the last received Frame number.

7.5.10 Device n SOF/EOP Count Register [W]

- Device 1 SOF/EOP Count Register 0xC094
- Device 2 SOF/EOP Count Register 0xC0B4

| | | | | | | | | |
|------------|----------|----|----------|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | Count... | | | | | |
| Read/Write | - | - | R | R | R | R | R | R |
| Default | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |

| | | | | | | | | |
|------------|----------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

Figure 7-38. Device n SOF/EOP Count Register
Register Description

The Device n SOF/EOP Count Register should be written with the time expected between receiving a SOF/EOPs. If the SOF/EOP counter expires before an SOF/EOP is received, an SOF/EOP Time-out Interrupt can be generated. The SOF/EOP Time-out Interrupt Enable and SOF/EOP Time-out Interrupt Flag are located in the Device n Interrupt Enable and Status Registers, respectively.

The SOF/EOP count should be set slightly greater than the expected SOF/EOP interval. The SOF/EOP counter decrements at a 12-MHz rate. Therefore in the case of an expected 1-ms SOF/EOP interval, the SOF/EOP count should be set slightly greater than 0x2EE0.

Count (Bits [13:0])

The Count field contains the current value of the SOF/EOP down counter. At power-up and reset, this value is set to 0x2EE0 and for expected 1-ms SOF/EOP intervals, this SOF/EOP count should be increased slightly.

Reserved

All reserved bits should be written as '0'.

7.6 OTG Control Registers

There is one register dedicated for OTG operation. This register is covered in this section and summarized in *Figure 7-39*.

| Register Name | Address | R/W |
|----------------------|---------|-----|
| OTG Control Register | C098H | R/W |

Figure 7-39. OTG Registers

7.6.1 OTG Control Register [0xC098] [R/W]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|----------|----|---------------------|-----------------|--------------------|-----------------------|-------------------|-------------------|
| Field | Reserved | | VBUS Pull-up Enable | Receive Disable | Charge Pump Enable | VBUS Discharge Enable | D+ Pull-up Enable | D- Pull-up Enable |
| Read/Write | - | - | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|---------------------|---------------------|----------|---|---|-----------------|-----------|-----------------|
| Field | D+ Pull-down Enable | D- Pull-down Enable | Reserved | | | OTG Data Status | ID Status | VBUS Valid Flag |
| Read/Write | R/W | R/W | - | - | - | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | X | X | X |

Figure 7-40. OTG Control Register

Register Description

The OTG Control Register allows control and monitoring over the OTG port on Port1A.

VBUS Pull-up Enable (Bit 13)

The VBUS Pull-up Enable bit enables or disables a 500Ω pull-up resistor onto OTG VBus.

- 1:** 500Ω pull-up resistor enabled
- 0:** 500Ω pull-up resistor disabled

Receive Disable (Bit 12)

The Receive Disable bit enables or powers down (disables) the OTG receiver section.

- 1:** OTG receiver powered down and disabled
- 0:** OTG receiver enabled

Charge Pump Enable (Bit 11)

The Charge Pump Enable bit enables or disables the OTG VBus charge pump.

- 1:** OTG VBus charge pump enabled
- 0:** OTG VBus charge pump disabled

VBUS Discharge Enable (Bit 10)

The VBUS Discharge Enable bit enables or disables a 2KΩ discharge pull-down resistor onto OTG VBus.

- 1:** 2KΩ pull-down resistor enabled
- 0:** 2KΩ pull-down resistor disabled

D+ Pull-up Enable (Bit 9)

The D+ Pull-up Enable bit enables or disables a pull-up resistor on the OTG D+ data line.

- 1: OTG D+ dataline pull-up resistor enabled
- 0: OTG D+ dataline pull-up resistor disabled

D– Pull-up Enable (Bit 8)

The D– Pull-up Enable bit enables or disables a pull-up resistor on the OTG D– data line.

- 1: OTG D– dataline pull-up resistor enabled
- 0: OTG D– dataline pull-up resistor disabled

D+ Pull-down Enable (Bit 7)

The D+ Pull-down Enable bit enables or disables a pull-down resistor on the OTG D+ data line.

- 1: OTG D+ dataline pull-down resistor enabled
- 0: OTG D+ dataline pull-down resistor disabled

D– Pull-down Enable (Bit 6)

The D– Pull-down Enable bit enables or disables a pull-down resistor on the OTG D- data line.

- 1: OTG D– dataline pull-down resistor enabled
- 0: OTG D– dataline pull-down resistor disabled

OTG Data Status (Bit 2)

The OTG Data Status bit is a read-only bit and indicates the TTL logic state of the OTG VBus pin.

- 1: OTG VBus is greater than 2.4V
- 0: OTG VBus is less than 0.8V

ID Status (Bit 1)

The ID Status bit is a read-only bit that indicates the state of the OTG ID pin on Port A.

- 1: OTG ID Pin is not connected directly to ground (>10kΩ)
- 0: OTG ID Pin is connected directly ground (< 10Ω)

VBUS Valid Flag (Bit 0)

The VBUS Valid Flag bit indicates whether OTG VBus is greater than 4.4V. After turning on VBUS, firmware should wait at least 10 μs before this reading this bit.

- 1: OTG VBus is greater then 4.4V
- 0: OTG VBus is less then 4.4V

Reserved

All reserved bits should be written as '0'.

7.7 GPIO Registers

There are seven registers dedicated for GPIO operations. These seven registers are covered in this section and summarized in *Figure 7-41*.

| Register Name | Address | R/W |
|----------------------------|---------|-----|
| GPIO Control Register | 0xC006 | R/W |
| GPIO0 Output Data Register | 0xC01E | R/W |
| GPIO0 Input Data Register | 0xC020 | R |
| GPIO0 Direction Register | 0xC022 | R/W |
| GPIO1 Output Data Register | 0xC024 | R/W |
| GPIO1 Input Data Register | 0xC026 | R |
| GPIO1 Direction Register | 0xC028 | R/W |

Figure 7-41. GPIO Registers

7.7.1 GPIO Control Register [0xC006] [R/W]

| | | | | | | | | |
|------------|----------------------|-----|----------|----|------------|-------------|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Write Protect Enable | UD | Reserved | | SAS Enable | Mode Select | | |
| Read/Write | R/W | R/W | R | - | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|----------|------------|----------|---|---|-----------------------------|--------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | HSS Enable | Reserved | SPI Enable | Reserved | | | Interrupt 0 Polarity Select | Interrupt 0 Enable |
| Read/Write | R/W | - | R/W | - | - | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-42. GPIO Control Register
Register Description

The GPIO Control Register configures the GPIO pins for various interface options. It also controls the polarity of the GPIO interrupt on IRQ0 (GPIO24).

Write Protect Enable (Bit 15)

The Write Protect Enable bit enables or disables the GPIO write protect. When Write Protect is enabled, the GPIO Mode Select [10:8] field read-only until a chip reset.

- 1:** Enable Write Protect
- 0:** Disable Write Protect

UD (Bit 14)

The UD bit routes the Host/Device 1A Port's transmitter enable status to GPIO[30]. This is for use with an external ESD protection circuit when needed.

- 1:** Route the signal to GPIO[30]
- 0:** Do not route the signal to GPIO[30]

SAS Enable (Bit 11)

The SAS Enable bit, when in SPI mode, will reroute the SPI port SPI_nSSI pin to GPIO[15] rather than GPIO[9].

- 1:** Reroute SPI_nssi to GPIO[15]
- 0:** Leave SPI_nssi on GPIO[9]

Mode Select (Bits [10:8])

The Mode Select field selects how GPIO[15:0] and GPIO[24:19] are used as defined in *Table 7-8*.

Table 7-8. Mode Select Definition

| Mode Select [10:8] | GPIO Configuration |
|--------------------|---|
| 111 | Reserved |
| 110 | SCAN — (HW) Scan diagnostic. For production test only. Not for normal operation |
| 101 | HPI — Host Port Interface |
| 100 | Reserved |
| 011 | Reserved |
| 010 | Reserved |
| 001 | Reserved |
| 000 | GPIO — General Purpose Input Output |

HSS Enable (Bit 7)

The HSS Enable bit routes HSS to GPIO[15:12].

1: HSS is routed to GPIO

0: HSS is not routed to GPIOs. GPIO[15:12] are free for other purposes.

SPI Enable (Bit 5)

The SPI Enable bit routes SPI to GPIO[11:8]. If the SAS Enable bit is set, it will override and route the SPI_nSSI pin to GPIO15.

1: SPI is routed to GPIO[11:8]

0: SPI is not routed to GPIO[11:8]. GPIO[11:8] are free for other purposes.

Interrupt 0 Polarity Select (Bit 1)

The Interrupt 0 Polarity Select bit selects the polarity for IRQ0.

1: Sets IRQ0 to rising edge

0: Sets IRQ0 to falling edge

Interrupt 0 Enable (Bit 0)

The Interrupt 0 Enable bit enables or disables IRQ0. The GPIO bit on the interrupt Enable Register must also be set in order for this for this interrupt to be enabled.

1: Enable IRQ0

0: Disable IRQ0

Reserved

All reserved bits should be written as '0'.

7.7.2 GPIO 0 Output Data Register [0xC01E] [R/W]

| | | | | | | | | |
|------------|--------|--------|--------|--------|--------|--------|-------|-------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-43. GPIO 0 Output Data Register

Register Description

The GPIO 0 Output Data Register controls the output data of the GPIO pins. The GPIO 0 Output Data Register controls GPIO15 to GPIO0 while the GPIO 1 Output Data Register controls GPIO31 to GPIO19. When read, this register reads back the last data written, not the data on pins configured as inputs (see Input Data Register).

Writing a 1 to any bit will output a high voltage on the corresponding GPIO pin.

Reserved

All reserved bits should be written as '0'.

7.7.3 GPIO 1 Output Data Register [0xC024] [R/W]

| | | | | | | | | |
|------------|--------|--------|--------|----------|----|----|---|--------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | GPIO31 | GPIO30 | GPIO29 | Reserved | | | | GPIO24 |
| Read/Write | R/W | R/W | R/W | - | - | - | - | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|--------|--------|--------|--------|--------|----------|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | Reserved | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-44. GPIO n Output Data Register
Register Description

The GPIO 1 Output Data Register controls the output data of the GPIO pins. The GPIO 0 Output Data Register controls GPIO15 to GPIO0 while the GPIO 1 Output Data Register controls GPIO31 to GPIO19. When read, this register reads back the last data written, not the data on pins configured as inputs (see Input Data Register).

Writing a 1 to any bit will output a high voltage on the corresponding GPIO pin.

Reserved

All reserved bits should be written as '0'.

7.7.4 GPIO 0 Input Data Register [0xC020] [R]

| | | | | | | | | |
|------------|--------|--------|--------|--------|--------|--------|-------|-------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-45. GPIO 0 Input Data Register
Register Description

The GPIO 0 Input Data Register reads the input data of the GPIO pins. The GPIO 0 Input Data Register reads from GPIO15 to GPIO0 while the GPIO 1 Input Data Register reads from GPIO31 to GPIO19.

Every bit represents the voltage of that GPIO pin.

7.7.5 GPIO 1 Input Data Register [0xC026] [R]

| | | | | | | | | |
|------------|--------|--------|--------|----------|----|----|---|--------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | GPIO31 | GPIO30 | GPIO29 | Reserved | | | | GPIO24 |
| Read/Write | R | R | R | - | - | - | - | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|--------|--------|--------|--------|--------|----------|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | Reserved | | |
| Read/Write | R | R | R | R | R | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-46. GPIO 1 Input Data Register

Register Description

The GPIO 1 Input Data Register reads the input data of the GPIO pins. The GPIO 0 Input Data Register reads from GPIO15 to GPIO0 while the GPIO 1 Input Data Register reads from GPIO31 to GPIO19.

Every bit represents the voltage of that GPIO pin.

7.7.6 GPIO 0 Direction Register [0xC022] [R/W]

| | | | | | | | | |
|------------|--------|--------|--------|--------|--------|--------|-------|-------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-47. GPIO 0 Direction Register
Register Description

The GPIO 0 Direction Register controls the direction of the GPIO data pins (input/output). The GPIO 0 Direction Register controls GPIO15 to GPIO0 while the GPIO 1 Direction Register controls GPIO31 to GPIO19.

When any bit of this register is set to '1', the corresponding GPIO data pin becomes an output. When any bit of this register is set to '0', the corresponding GPIO data pin becomes an input.

Reserved

All reserved bits should be written as '0'.

7.7.7 GPIO 1 Direction Register [0xC028] [R/W]

| | | | | | | | | |
|------------|--------|--------|--------|----------|-----|-----|-----|--------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | GPIO31 | GPIO30 | GPIO29 | Reserved | | | | GPIO24 |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|--------|--------|--------|--------|--------|----------|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | Reserved | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-48. GPIO 1 Direction Register
Register Description

The GPIO 1 Direction Register controls the direction of the GPIO data pins (input/output). The GPIO 0 Direction Register controls GPIO15 to GPIO0 while the GPIO 1 Direction Register controls GPIO31 to GPIO19.

When any bit of this register is set to '1', the corresponding GPIO data pin becomes an output. When any bit of this register is set to '0', the corresponding GPIO data pin becomes an input.

Reserved

All reserved bits should be written as '0'.

7.8 HSS Registers

There are eight registers dedicated to HSS operation. Each of these registers are covered in this section and summarized in Figure 7-49.

| Register Name | Address | R/W |
|-------------------------------|---------|-----|
| HSS Control Register | 0xC070 | R/W |
| HSS Baud Rate Register | 0xC072 | R/W |
| HSS Transmit Gap Register | 0xC074 | R/W |
| HSS Data Register | 0xC076 | R/W |
| HSS Receive Address Register | 0xC078 | R/W |
| HSS Receive Length Register | 0xC07A | R/W |
| HSS Transmit Address Register | 0xC07C | R/W |
| HSS Transmit Length Register | 0xC07E | R/W |

Figure 7-49. HSS Registers

7.8.1 HSS Control Register [0xC070] [R/W]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|------------|---------------------|---------------------|------|-------------|------------|--------------------------|-----------------------|
| Field | HSS Enable | RTS Polarity Select | CTS Polarity Select | XOFF | XOFF Enable | CTS Enable | Receive Interrupt Enable | Done Interrupt Enable |
| Read/Write | R/W | R/W | R/W | R | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|--------------------------------|-------------------------------|--------------|----------------|--------------------|-----------------------|---------------------------|--------------------|
| Field | Transmit Done Interrupt Enable | Receive Done Interrupt Enable | One Stop Bit | Transmit Ready | Packet Mode Select | Receive Overflow Flag | Receive Packet Ready Flag | Receive Ready Flag |
| Read/Write | R/W | R/W | R/W | R | R/W | R/W | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-50. HSS Control Register

Register Description

The HSS Control Register provides high-level status and control over the HSS port.

HSS Enable (Bit 15)

The HSS Enable bit enables or disables HSS operation.

- 1:** Enables HSS operation
- 0:** Disables HSS operation

RTS Polarity Select (Bit 14)

The RTS Polarity Select bit selects the polarity of RTS.

- 1:** RTS is true when LOW
- 0:** RTS is true when HIGH

CTS Polarity Select (Bit 13)

The CTS Polarity Select bit selects the polarity of CTS.

- 1:** CTS is true when LOW
- 0:** CTS is true when HIGH

XOFF (Bit 12)

The XOFF bit is a read-only bit that indicates if an XOFF has been received. This bit will automatically clear when an XON has been received.

- 1:** XOFF received
- 0:** XON received

XOFF Enable (Bit 11)

The XOFF Enable bit enables or disables XON/XOFF software handshaking.

1: Enable XON/XOFF software handshaking

0: Disable XON/XOFF software handshaking

CTS Enable (Bit 10)

The CTS Enable bit enables or disables CTS/RTS hardware handshaking.

1: Enable CTS/RTS hardware handshaking

0: Disable CTS/RTS hardware handshaking

Receive Interrupt Enable (Bit 9)

The Receive Interrupt Enable bit enables or disables the Receive Ready and Receive Packet Ready interrupts.

1: Enable the Receive Ready and Receive Packet Ready interrupts

0: Disable the Receive Ready and Receive Packet Ready interrupts

Done Interrupt Enable (Bit 8)

The Done Interrupt Enable bit enables or disables the Transmit Done and Receive Done interrupts.

1: Enable the Transmit Done and Receive Done interrupts

0: Disable the Transmit Done and Receive Done interrupts

Transmit Done Interrupt Flag (Bit 7)

The Transmit Done Interrupt Flag bit indicates the status of the Transmit Done Interrupt. It will set when a block transmit is finished. To clear the interrupt, a '1' should be written to this bit.

1: Interrupt triggered

0: Interrupt did not trigger

Receive Done Interrupt Flag (Bit 6)

The Receive Done Interrupt Flag bit indicates the status of the Receive Done Interrupt. It will set when a block transmit is finished. To clear the interrupt, a '1' should be written to this bit.

1: Interrupt triggered

0: Interrupt did not trigger

One Stop Bit (Bit 5)

The One Stop Bit bit selects between one and two stop bits for transmit byte mode. In receive mode, the number of stop bits may vary and does not need to be fixed.

1: One stop bit

0: Two stop bits

Transmit Ready (Bit 4)

The Transmit Ready bit is a read only bit that indicates if the HSS Transmit FIFO is ready for the CPU to load new data for transmission.

1: HSS transmit FIFO ready for loading

0: HSS transmit FIFO not ready for loading

Packet Mode Select (Bit 3)

The Packet Mode Select bit selects between Receive Packet Ready and Receive Ready as the interrupt source for the RxIntr interrupt.

1: Selects Receive Packet Ready as the source

0: Selects Receive Ready as the source

Receive Overflow Flag (Bit 2)

The Receive Overflow Flag bit indicates if the Receive FIFO overflowed when set. This flag can be cleared by writing a '1' to this bit.

1: Overflow occurred

0: Overflow did not occur

Receive Packet Ready Flag (Bit 1)

The Receive Packet Ready Flag bit is a read only bit that indicates if the HSS receive FIFO is full with eight bytes or not.

1: HSS receive FIFO is full

0: HSS receive FIFO is not full

Receive Ready Flag (Bit 0)

The Receive Ready Flag is a read only bit that indicates if the HSS receive FIFO is empty or not.

1: HSS receive FIFO is not empty (one or more bytes is reading for reading)

0: HSS receive FIFO is empty

7.8.2 HSS Baud Rate Register [0xC072] [R/W]

| | | | | | | | | |
|------------|----------|-----|-----|---------|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | Baud... | | | | |
| Read/Write | - | - | - | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Baud | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |

Figure 7-51. HSS Baud Rate Register
Register Description

The HSS Baud Rate Register will set the HSS Baud Rate. At reset, the default value is 0x0017 which will set the baud rate to 2.0 MHz.

Baud (Bits [12:0])

The Baud field is the baud rate divisor minus one, in units of 1/48 MHz. Therefore the Baud Rate = 48 MHz/(Baud + 1). This puts a constraint on the Baud Value as follows: $(24 - 1) \leq \text{Baud} \leq (5000 - 1)$

Reserved

All reserved bits should be written as '0'.

7.8.3 HSS Transmit Gap Register [0xC074] [R/W]

| | | | | | | | | |
|------------|---------------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Transmit Gap Select | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |

Figure 7-52. HSS Transmit Gap Register
Register Description

The HSS Transmit Gap Register is only valid in block transmit mode. It allows for a programmable number of stop bits to be inserted thus overwriting the One Stop Bit in the HSS Control Register. The default reset value of this register is 0x0009, equivalent to two stop bits.

Transmit Gap Select (Bits [7:0])

The Transmit Gap Select field sets the inactive time between transmitted bytes. The inactive time = (Transmit Gap Select - 7) * bit time. Therefore an Transmit Gap Select Value of 8 is equal to having one Stop bit.

Reserved

All reserved bits should be written as '0'.

7.8.4 HSS Data Register [0xC076] [R/W]

| | | | | | | | | |
|------------|----------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Data | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-53. HSS Data Register
Register Description

The HSS Data Register contains data received on the HSS port (not for block receive mode) when read. This receive data is valid when the Receive Ready bit of the HSS Control Register is set to '1'. Writing to this register will initiate a single byte transfer of data. The Transmit Ready Flag in the HSS Control Register should read '1' before writing to this register (this avoids disrupting the previous/current transmission).

Data (Bits [7:0])

The Data field contains the data received or to be transmitted on the HSS port.

Reserved

All reserved bits should be written as '0'.

7.8.5 HSS Receive Address Register [0xC078] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-54. HSS Receive Address Register
Register Description

The HSS Receive Address Register is used as the base pointer address for the next HSS block receive transfer.

Address (Bits [15:0])

The Address field sets the base pointer address for the next HSS block receive transfer.

7.8.6 HSS Receive Counter Register [0xC07A] [R/W]

| | | | | | | | | |
|------------|----------|----|----|----|----|----|------------|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | Counter... | |
| Read/Write | - | - | - | - | - | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Counter | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-55. HSS Receive Counter Register
Register Description

The HSS Receive Counter Register designates the block byte length for the next HSS receive transfer. This register should be loaded with the word count minus one to start the block receive transfer. As each byte is received this register value is decremented. When read, this register indicates the remaining length of the transfer.

Counter (Bits [9:0])

The Counter field value is equal to the word count minus one giving a maximum value of 0x03FF (1023) or 2048 bytes. When the transfer is complete this register returns 0x03FF until reloaded.

Reserved

All reserved bits should be written as '0'.

7.8.7 HSS Transmit Address Register [0xC07C] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-56. HSS Transmit Address Register
Register Description

The HSS Transmit Address Register is used as the base pointer address for the next HSS block transmit transfer.

Address (Bits [15:0])

The Address field sets the base pointer address for the next HSS block transmit transfer.

7.8.8 HSS Transmit Counter Register [0xC07E] [R/W]

| | | | | | | | | |
|------------|----------|----|----|----|----|----|------------|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | Counter... | |
| Read/Write | - | - | - | - | - | - | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Counter | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-57. HSS Transmit Counter Register
Register Description

The HSS Transmit Counter Register designates the block byte length for the next HSS transmit transfer. This register should be loaded with the word count minus one to start the block transmit transfer. As each byte is transmitted this register value is decremented. When read, this register indicates the remaining length of the transfer.

Counter (Bits [9:0])

The Counter field value is equal to the word count minus one giving a maximum value of 0x03FF (1023) or 2048 bytes. When the transfer is complete this register returns 0x03FF until reloaded.

Reserved

All reserved bits should be written as '0'.

7.9 HPI Registers

There are five registers dedicated to HPI operation. In addition, there is an HPI status port which can be address over HPI. Each of these registers is covered in this section and are summarized in *Figure 7-58*.

| Register Name | Address | R/W |
|----------------------------|---------|-----|
| HPI Breakpoint Register | 0x0140 | R |
| Interrupt Routing Register | 0x0142 | R |
| SIE1msg Register | 0x0144 | W |
| SIE2msg Register | 0x0148 | W |
| HPI Mailbox Register | 0xC0C6 | R/W |

Figure 7-58. HPI Registers
7.9.1 HPI Breakpoint Register [0x0140] [R]

| | | | | | | | | |
|------------|------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-59. HPI Breakpoint Register
Register Description

The HPI Breakpoint Register is a special onchip memory location which the external processor can access using normal HPI memory read/write cycles. This register is read only by the CPU but is read/write by the HPI port. The contents of this register have the same effect as the Breakpoint Register [0xC014]. This special Breakpoint Register is used by software debuggers which interface through the HPI port instead of the serial port.

When the program counter matches the Breakpoint Address, the INT127 interrupt will trigger. To clear this interrupt, a zero value should be written to this register.

Address (Bits [15:0])

The Address field is a 16-bit field containing the breakpoint address.

7.9.2 Interrupt Routing Register [0x0142] [R]

| | | | | | | | | |
|------------|--------------------|------------------|------------------------|------------------------|------------------------|------------------------|----------------------|-------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | VBUS to HPI Enable | ID to HPI Enable | SOF/EOP2 to HPI Enable | SOF/EOP2 to CPU Enable | SOF/EOP1 to HPI Enable | SOF/EOP1 to CPU Enable | Reset2 to HPI Enable | HPI Swap 1 Enable |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |

| | | | | | | | | |
|------------|-----------------------|-----------------------|----------|---|---------------------|---------------------|----------------------|-------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Resume2 to HPI Enable | Resume1 to HPI Enable | Reserved | | Done2 to HPI Enable | Done1 to HPI Enable | Reset1 to HPI Enable | HPI Swap 0 Enable |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-60. Interrupt Routing Register

Register Description

The Interrupt Routing Register allows the HPI port to take over some or all of the SIE interrupts that usually go to the on-chip CPU. This register is read only by the CPU but is read/write by the HPI port. By setting the appropriate bit to '1', the SIE interrupt is routed to the HPI port to become the HPI_INTR signal and also readable in the HPI Status Register. The bits in this register select where the interrupts are routed. The individual interrupt enable is handled in the SIE interrupt enable register.

VBUS to HPI Enable (Bit 15)

The VBUS to HPI Enable bit routes the OTG VBUS interrupt to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

ID to HPI Enable (Bit 14)

The ID to HPI Enable bit routes the OTG ID interrupt to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

SOF/EOP2 to HPI Enable (Bit 13)

The SOF/EOP2 to HPI Enable bit routes the SOF/EOP2 interrupt to the HPI port.

1: Route signal to HPI port

0: Do not route signal to HPI port

SOF/EOP2 to CPU Enable (Bit 12)

The SOF/EOP2 to CPU Enable bit routes the SOF/EOP2 interrupt to the on-chip CPU. Since the SOF/EOP2 interrupt can be routed to both the on-chip CPU and the HPI port the firmware must ensure only one of the two (CPU, HPI) resets the interrupt.

1: Route signal to CPU

0: Do not route signal to CPU

SOF/EOP1 to HPI Enable (Bit 11)

The SOF/EOP1 to HPI Enable bit routes the SOF/EOP1 interrupt to the HPI port.

1: Route signal to HPI port

0: Do not route signal to HPI port

SOF/EOP1 to CPU Enable (Bit 10)

The SOF/EOP1 to CPU Enable bit routes the SOF/EOP1 interrupt to the on-chip CPU. Since the SOF/EOP1 interrupt can be routed to both the on-chip CPU and the HPI port the firmware must ensure only one of the two (CPU, HPI) resets the interrupt.

1: Route signal to CPU

0: Do not route signal to CPU

Reset2 to HPI Enable (Bit 9)

The Reset2 to HPI Enable bit routes the USB Reset interrupt that occurs on Device 2 to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

HPI Swap 1 Enable (Bit 8)

Both HPI Swap bits (bits 8 and 0) must be set to identical values. When set to '00', the most significant data byte goes to HPI_D[15:8] and the least significant byte goes to HPI_D[7:0]. This is the default setting. By setting to '11', the most significant data byte goes to HPI_D[7:0] and the least significant byte goes to HPI_D[15:8].

Resume2 to HPI Enable (Bit 7)

The Resume2 to HPI Enable bit routes the USB Resume interrupt that occurs on Host 2 to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

Resume1 to HPI Enable (Bit 6)

The Resume1 to HPI Enable bit routes the USB Resume interrupt that occurs on Host 1 to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

Done2 to HPI Enable (Bit 3)

The Done2 to HPI Enable bit routes the Done interrupt for Host/Device 2 to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

Done1 to HPI Enable (Bit 2)

The Done1 to HPI Enable bit routes the Done interrupt for Host/Device 1 to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

Reset1 to HPI Enable (Bit 1)

The Reset1 to HPI Enable bit routes the USB Reset interrupt that occurs on Device 1 to the HPI port instead of the on-chip CPU.

1: Route signal to HPI port

0: Do not route signal to HPI port

HPI Swap 0 Enable (Bit 0)

Both HPI Swap bits (bits 8 and 0) must be set to identical values. When set to '00', the most significant data byte goes to HPI_D[15:8] and the least significant byte goes to HPI_D[7:0]. This is the default setting. By setting to '11', the most significant data byte goes to HPI_D[7:0] and the least significant byte goes to HPI_D[15:8].

7.9.3 SIEXmsg Register [W]

- SIE1msg Register 0x0144
- SIE2msg Register 0x0148

| | | | | | | | | |
|------------|---------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Data... | | | | | | | |
| Read/Write | W | W | W | W | W | W | W | W |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|---------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Data | | | | | | | |
| Read/Write | W | W | W | W | W | W | W | W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-61. SIEXmsg Register
Register Description

The SIEXmsg Register allows an interrupt to be generated on the HPI port. Any write to this register will cause the SIEXmsg flag in the HPI Status Port to go high. If the SIEXmsg interrupt enable bit is set, this will also cause an interrupt on the HPI_INTR pin. The SIEXmsg flag is automatically cleared when the HPI port reads from this register.

Data (Bits [15:0])

The Data field[15:0] simply needs to have any value written to it to cause SIEXmsg flag in the HPI Status Port to go high.

7.9.4 HPI Mailbox Register [0xC0C6] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Message... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Message | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-62. HPI Mailbox Register
Register Description

The HPI Mailbox Register provides a common mailbox between the CY7C67200 and the external host processor.

If enabled, the HPI Mailbox RX Full interrupt will trigger when the external host processor writes to this register. When the CY7C67200 reads this register the HPI Mailbox RX Full interrupt will automatically get cleared.

If enabled, the HPI Mailbox TX Empty interrupt will trigger when the external host processor reads from this register. The HPI Mailbox TX Empty interrupt will automatically clear when the CY7C67200 writes to this register.

In addition, when the CY7C67200 writes to this register, the HPI_INTR signal on the HPI port will assert signaling the external processor that there is data in the mailbox to read. The HPI_INTR signal will de-assert when the external host processor reads from this register.

Message (Bits [15:0])

The Message field contains the message that the host processor wrote to the HPI Mailbox Register.

7.9.5 HPI Status Port [] [HPI: R]

| | | | | | | | | |
|------------|-----------|---------|----------|---------------|----------|---------------|-------------|-----------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | VBUS Flag | ID Flag | Reserved | SOF/EOP2 Flag | Reserved | SOF/EOP1 Flag | Reset2 Flag | Mailbox In Flag |
| Read/Write | R | R | - | R | - | R | R | R |
| Default | X | X | X | X | X | X | X | X |

| | | | | | | | | |
|------------|--------------|--------------|---------|---------|------------|------------|-------------|------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Resume2 Flag | Resume1 Flag | SIE2msg | SIE1msg | Done2 Flag | Done1 Flag | Reset1 Flag | Mailbox Out Flag |
| Read/Write | R | R | R | R | R | R | R | R |
| Default | X | X | X | X | X | X | X | X |

Figure 7-63. HPI Status Port
Register Description

The HPI Status Port provides the external host processor with the MailBox status bits plus several SIE status bits. This register is not accessible from the on-chip CPU. The additional SIE status bits are provided to aid external device driver firmware development, and are not recommended for applications that do not have an intimate relationship with the on-chip BIOS.

Reading from the HPI Status Port does not result in a CPU HPI interface memory access cycle. The external host may continuously poll this register without degrading the CPU or DMA performance.

VBUS Flag (Bit 15)

The VBUS Flag bit is a read-only bit that indicates whether OTG VBus is greater than 4.4V. After turning on VBUS, firmware should wait at least 10 μ s before this reading this bit.

1: OTG VBus is greater then 4.4V

0: OTG VBus is less then 4.4V

ID Flag (Bit 14)

The ID Flag bit is a read-only bit that indicates the state of the OTG ID pin.

SOF/EOP2 Flag (Bit 12)

The SOF/EOP2 Flag bit is a read-only bit that indicates if a SOF/EOP interrupt occurs on either Host/Device 2.

1: Interrupt triggered

0: Interrupt did not trigger

SOF/EOP1 Flag (Bit 10)

The SOF/EOP1 Flag bit is a read-only bit that indicates if a SOF/EOP interrupt occurs on either Host/Device 1.

1: Interrupt triggered

0: Interrupt did not trigger

Reset2 Flag (Bit 9)

The Reset2 Flag bit is a read-only bit that indicates if a USB Reset interrupt occurs on either Host/Device 2.

1: Interrupt triggered

0: Interrupt did not trigger

Mailbox In Flag (Bit 8)

The Mailbox In Flag bit is a read-only bit that indicates if a message is ready in the incoming mailbox. This interrupt clears when onchip CPU reads from the HPI Mailbox Register.

1: Interrupt triggered

0: Interrupt did not trigger

Resume2 Flag (Bit 7)

The Resume2 Flag bit is a read-only bit that indicates if a USB resume interrupt occurs on either Host/Device 2.

1: Interrupt triggered

0: Interrupt did not trigger

Resume1 Flag (Bit 6)

The Resume1 Flag bit is a read-only bit that indicates if a USB resume interrupt occurs on either Host/Device 1.

1: Interrupt triggered

0: Interrupt did not trigger

SIE2msg (Bit 5)

The SIE2msg Flag bit is a read only bit that indicates if the CY7C67200 CPU has written to the SIE2msg register. This bit will clear on an HPI read.

1: The SIE2msg register has been written by the CY7C67200 CPU

0: The SIE2msg register has not been written by the CY7C67200 CPU

SIE1msg (Bit 4)

The SIE1msg Flag bit is a read only bit that indicates if the CY7C67200 CPU has written to the SIE1msg register. This bit will clear on an HPI read.

1: The SIE1msg register has been written by the CY7C67200 CPU

0: The SIE1msg register has not been written by the CY7C67200 CPU

Done2 Flag (Bit 3)

In host mode the Done2 Flag bit is a read-only bit that indicates if a host packet done interrupt occurs on Host 2. In device mode this read-only bit indicates if any of the endpoint interrupts occurs on Device 2. Firmware will need to determine which endpoint interrupt occurred.

1: Interrupt triggered

0: Interrupt did not trigger

Done1 Flag (Bit 2)

In host mode the Done 1 Flag bit is a read-only bit that indicates if a host packet done interrupt occurs on Host 1. In device mode this read-only bit indicates if any of the endpoint interrupts occurs on Device 1. Firmware will need to determine which endpoint interrupt occurred.

1: Interrupt triggered

0: Interrupt did not trigger

Reset1 Flag (Bit 1)

The Reset1 Flag bit is a read-only bit that indicates if a USB Reset interrupt occurs on either Host/Device 1.

1: Interrupt triggered

0: Interrupt did not trigger

Mailbox Out Flag (Bit 0)

The Mailbox Out Flag bit is a read only bit that indicates if a message is ready in the outgoing mailbox. This interrupt clears when the external host reads from the HPI Mailbox Register.

1: Interrupt triggered

0: Interrupt did not trigger

7.10 SPI Registers

There are 12 registers dedicated to SPI operation. Each register is covered in this section and summarized in *Figure 7-64*.

| Register Name | Address | R/W |
|-------------------------------|---------|-----|
| SPI Configuration Register | 0xC0C8 | R/W |
| SPI Control Register | 0xC0CA | R/W |
| SPI Interrupt Enable Register | 0xC0CC | R/W |
| SPI Status Register | 0xC0CE | R |
| SPI Interrupt Clear Register | 0xC0D0 | W |
| SPI CRC Control Register | 0xC0D2 | R/W |
| SPI CRC Value | 0xC0D4 | R/W |
| SPI Data Register | 0xC0D6 | R/W |
| SPI Transmit Address Register | 0xC0D8 | R/W |
| SPI Transmit Count Register | 0xC0DA | R/W |
| SPI Receive Address Register | 0xC0DC | R/W |
| SPI Receive Count Register | 0xC0DE | R/W |

Figure 7-64. SPI Registers

7.10.1 SPI Configuration Register [0xC0C8] [R/W]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|--------------|--------------|---------------------|--------------|-----|-----|-----|----------|
| Field | 3Wire Enable | Phase Select | SCK Polarity Select | Scale Select | | | | Reserved |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | - |
| Default | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|----------------------|---------------|-----------|-----------------|-----|-----|-----|-----|
| Field | Master Active Enable | Master Enable | SS Enable | SS Delay Select | | | | |
| Read/Write | R | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |

Figure 7-65. SPI Configuration Register

Register Description

The SPI Configuration Register controls the SPI port. Fields apply to both master and slave mode unless otherwise noted.

3Wire Enable (Bit 15)

The 3Wire Enable bit indicates if the MISO and MOSI data lines are tied together allowing only half duplex operation.

- 1:** MISO and MOSI data lines are tied together
- 0:** Normal MISO and MOSI Full Duplex operation (not tied together)

Phase Select (Bit 14)

The Phase Select bit selects advanced or delayed SCK phase. This field only applies to master mode.

- 1:** Advanced SCK phase
- 0:** Delayed SCK phase

SCK Polarity Select (Bit 13)

This SCK Polarity Select bit selects the polarity of SCK.

- 1:** Positive SCK polarity
- 0:** Negative SCK polarity

Scale Select (Bits [12:9])

The Scale Select field provides control over the SCK frequency, based on 48 MHz. See *Table 7-9* for a definition of this field. This field only applies to master mode.

Table 7-9. Scale Select Field Definition for SCK Frequency

| Scale Select [12:9] | SCK Frequency |
|---------------------|---------------|
| 0000 | 12 MHz |
| 0001 | 8 MHz |
| 0010 | 6 MHz |
| 0011 | 4 MHz |
| 0100 | 3 MHz |
| 0101 | 2 MHz |
| 0110 | 1.5 MHz |
| 0111 | 1 MHz |
| 1000 | 750 KHz |
| 1001 | 500 KHz |
| 1010 | 375 KHz |
| 1011 | 250 KHz |
| 1100 | 375 KHz |
| 1101 | 250 KHz |
| 1110 | 375 KHz |
| 1111 | 250 KHz |

Master Active Enable (Bit 7)

The Master Active Enable bit is a read only bit that indicates if the master state machine is active or idle. This field only applies to master mode.

- 1:** Master state machine is active
- 0:** Master state machine is idle

Master Enable (Bit 6)

The Master Enable bit sets the SPI interface to master or slave. This bit is only writable when the Master Active Enable bit reads '0', otherwise value will not change.

- 1:** Master SPI interface
- 0:** Slave SPI interface

SS Enable (Bit 5)

The SS Enable bit enables or disables the master SS output.

- 1:** Enable master SS output
- 0:** Disable master SS output (three-state master SS output, for single SS line in slave mode)

SS Delay Select (Bits [4:0])

When the SS Delay Select field is set to '00000' this indicates manual mode. In manual mode SS is controlled by the SS Manual bit of the SPI Control Register. When the SS Delay Select field is set between '00001' to '11111', this value indicates the count in half bit times of auto transfer delay for: SS LOW to SCK active, SCK inactive to SS HIGH, SS HIGH time. This field only applies to master mode.

7.10.2 SPI Control Register [0xC0CA] [R/W]

| | | | | | | | | |
|------------|------------|-----------|-----------|-------------|-----------|-------------|----------------|--------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | SCK Strobe | FIFO Init | Byte Mode | Full Duplex | SS Manual | Read Enable | Transmit Ready | Receive Data Ready |
| Read/Write | W | W | R/W | R/W | R/w | R/W | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

| | | | | | | | | |
|------------|----------------|--------------|---------------------|-----|-----|--------------------|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Transmit Empty | Receive Full | Transmit Bit Length | | | Receive Bit Length | | |
| Read/Write | R | R | R/W | R/W | R/W | R/W | R/w | R/W |
| Default | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-66. SPI Control Register
Register Description

The SPI Control Register controls the SPI port. Fields apply to both master and slave mode unless otherwise noted.

SCK Strobe (Bit 15)

The SCK Strobe bit starts the SCK strobe at the selected frequency and polarity (set in the SPI Configuration Register), but not phase. This bit feature can only be enabled when in master mode and must be during a period of inactivity. This bit is self clearing.

1: SCK Strobe Enable

0: No Function

FIFO Init (Bit 14)

The FIFO Init bit will initialize the FIFO and clear the FIFO Error Status bit. This bit is self clearing.

1: FIFO Init Enable

0: No Function

Byte Mode (Bit 13)

The Byte Mode bit selects between PIO (byte mode) and DMA (block mode) operation.

1: Set PIO (byte mode) operation

0: Set DMA (block mode) operation

Full Duplex (Bit 12)

The Full Duplex bit selects between full duplex and half duplex operation.

1: Enable full duplex. Full duplex is not allowed and will not set if the 3Wire Enable bit of the SPI Configuration Register is set to '1'

0: Enable half duplex operation

SS Manual (Bit 11)

The SS Manual bit activates or deactivates SS if the SS Delay Select field of the SPI Control Register is all zeros and is configured as master interface. This field only applies to master mode.

1: Activate SS, master drives SS line asserted LOW

0: Deactivate SS, master drives SS line deasserted HIGH

Read Enable (Bit 10)

The Read Enable bit will initiate a read phase for a master mode transfer or set the slave to receive (in slave mode).

1: Initiates a read phase for a master transfer or sets a slave to receive. In master mode this bit is sticky and remains set until the read transfer begins.

0: Initiates the write phase for slave operation

Transmit Ready (Bit 9)

The Transmit Ready bit is a read-only bit that indicates if the transmit port is ready to empty and ready to be written.

1: Ready for data to be written to the port. The transmit FIFO is not full.

0: Not ready for data to be written to the port

Receive Data Ready (Bit 8)

The Receive Data Ready bit is a read-only bit that indicates if the receive port has data ready.

- 1: Receive port has data ready to read
- 0: Receive port does not have data ready

Transmit Empty (Bit 7)

The Transmit Empty bit is a read-only bit that indicates if the transmit FIFO is empty.

- 1: Transmit FIFO is empty
- 0: Transmit FIFO is not empty

Receive Full (Bit 6)

The Receive Full bit is a read-only bit that indicates if the receive FIFO is full.

- 1: Receive FIFO is full
- 0: Receive FIFO is not full

Transmit Bit Length (Bits [5:3])

The Transmit Bit Length field controls whether a full byte or partial byte is to be transmitted. If Transmit Bit Length is '000', a full byte will be transmitted. If Transmit Bit Length is '001' to '111', the value indicates the number of bits that will be transmitted.

Receive Bit Length (Bits [2:0])

The Receive Bit Length field controls whether a full byte or partial byte will be received. If Receive Bit Length is '000' then a full byte will be received. If Receive Bit Length is '001' to '111', then the value indicates the number of bits that will be received.

7.10.3 SPI Interrupt Enable Register [0xC0CC] [R/W]

| | | | | | | | | |
|------------|-------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|---|---|---|---|--------------------------|---------------------------|---------------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | | | | | Receive Interrupt Enable | Transmit Interrupt Enable | Transfer Interrupt Enable |
| Read/Write | - | - | - | - | - | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-67. SPI Interrupt Enable Register

Register Description

The SPI Interrupt Enable Register controls the SPI port.

Receive Interrupt Enable (Bit 2)

The Receive Interrupt Enable bit will enable or disable the byte mode receive interrupt (RxIntVal).

- 1: Enable byte mode receive interrupt
- 0: Disable byte mode receive interrupt

Transmit Interrupt Enable (Bit 1)

The Transmit Interrupt Enable bit will enable or disable the byte mode transmit interrupt (TxIntVal).

- 1: Enables byte mode transmit interrupt
- 0: Disables byte mode transmit interrupt

Transfer Interrupt Enable (Bit 0)

The Transfer Interrupt Enable bit will enable or disable the block mode interrupt (XfrBlkIntVal).

- 1: Enables block mode interrupt
- 0: Disables block mode interrupt

Reserved

All reserved bits should be written as '0'.

7.10.4 SPI Status Register [0xC0CE] [R]

| | | | | | | | | |
|------------|-----------------|----------|----|----|----|------------------------|-------------------------|-------------------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | FIFO Error Flag | Reserved | | | | Receive Interrupt Flag | Transmit Interrupt Flag | Transfer Interrupt Flag |
| Read/Write | R | - | - | - | - | R | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-68. SPI Status Register

Register Description

The SPI Status Register is a read only register that provides status for the SPI port.

FIFO Error Flag (Bit 7)

The FIFO Error Flag bit is a read only bit that indicates if a FIFO error occurred. When this bit is set to '1' and the Transmit Empty bit of the SPI Control Register is set to '1', then a Tx FIFO underflow has occurred. Similarly, when set with the Receive Full bit of the SPI Control Register, a Rx FIFO overflow has occurred. This bit automatically clear when the SPI FIFO Init Enable bit of the SPI Control register is set.

1: Indicates FIFO error

0: Indicates no FIFO error

Receive Interrupt Flag (Bit 2)

The Receive Interrupt Flag is a read only bit that indicates if a byte mode receive interrupt has triggered.

1: Indicates a byte mode receive interrupt has triggered

0: Indicates a byte mode receive interrupt has not triggered

Transmit Interrupt Flag (Bit 1)

The Transmit Interrupt Flag is a read only bit that indicates a byte mode transmit interrupt has triggered.

1: Indicates a byte mode transmit interrupt has triggered

0: Indicates a byte mode transmit interrupt has not triggered

Transfer Interrupt Flag (Bit 0)

The Transfer Interrupt Flag is a read only bit that indicates a block mode interrupt has triggered.

1: Indicates a block mode interrupt has triggered

0: Indicates a block mode interrupt has not triggered

7.10.5 SPI Interrupt Clear Register [0xC0D0] [W]

| | | | | | | | | |
|------------|----------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|----------|---|---|---|---|---|-----------------------------|-----------------------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Reserved | | | | | | Transmit Interrupt Clear | Transfer Interrupt Clear |
| Read/Write | - | - | - | - | - | - | W | W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-69. SPI Interrupt Clear Register
Register Description

The SPI Interrupt Clear Register is a write-only register that allows the SPI Transmit and SPI Transfer Interrupts to be cleared.

Transmit Interrupt Clear (Bit 1)

The Transmit Interrupt Clear bit is a write-only bit that will clear the byte mode transmit interrupt. This bit is self clearing.

1: Clear the byte mode transmit interrupt

0: No function

Transfer Interrupt Clear (Bit 0)

The Transfer Interrupt Clear bit is a write-only bit that will clear the block mode interrupt. This bit is self clearing.

1: Clear the block mode interrupt

0: No function

Reserved

All reserved bits should be written as '0'.

7.10.6 SPI CRC Control Register [0xC0D2] [R/W]

| | | | | | | | | |
|------------|----------|-----|---------------|--------------|----------------|---------------|----------------|-------------|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | CRC Mode | | CRC Enable | CRC Clear | Receive CRC | One in CRC | Zero in CRC | Reserved... |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R | R | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|---|---|---|---|---|---|---|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-70. SPI CRC Control Register
Register Description

The SPI CRC Control Register provides control over the CRC source and polynomial value.

CRC Mode (Bits [15:14])

The CRCMode field selects the CRC polynomial as defined in *Table 7-10*.

Table 7-10. CRC Mode Definition

| CRCMode [9:8] | CRC Polynomial |
|---------------|--|
| 00 | MMC 16-bit: $X^{16} + X^{12} + X^5 + 1$ (CCITT Standard) |
| 01 | CRC7 7-bit: $X^7 + X^3 + 1$ |
| 10 | MST 16-bit: $X^{16} + X^{15} + X^2 + 1$ |
| 11 | Reserved, 16-bit polynomial 1. |

CRC Enable (Bit 13)

The CRC Enable bit will enable or disable the CRC operation.

- 1: Enables CRC operation
- 0: Disables CRC operation

CRC Clear (Bit 12)

The CRC Clear bit will clear the CRC with a load of all ones. This bit is self clearing and always reads '0'.

- 1: Clear CRC with all ones
- 0: No Function

Receive CRC (Bit 11)

The Receive CRC bit determines whether the receive bit stream or the transmit bit stream is used for the CRC data input in full duplex mode. This bit is a don't care in half duplex mode.

- 1: Assigns the receive bit stream
- 0: Assigns the transmit bit stream

One in CRC (Bit 10)

The One in CRC bit is a read-only bit that indicates if the CRC value is all zeros or not.

- 1: CRC value is not all zeros
- 0: CRC value is all zeros

Zero in CRC (Bit 9)

The Zero in CRC bit is a read-only bit that indicates if the CRC value is all ones or not.

- 1: CRC value is not all ones
- 0: CRC value is all ones

Reserved

All reserved bits should be written as '0'.

7.10.7 SPI CRC Value Register [0xC0D4] [R/W]

| | | | | | | | | |
|------------|--------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | CRC... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...CRC | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Figure 7-71. SPI CRC Value Register

Register Description

The SPI CRC Value Register contains the CRC value.

CRC (Bits [15:0])

The CRC field contains the SPI CRC. In CRC Mode CRC7, the CRC value will be a seven bit value [6:0]. Therefore bits [15:7] are invalid in CRC7 mode.

7.10.8 SPI Data Register [0xC0D6] [R/W]

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | X | X | X | X | X | X | X | X |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Data | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | X | X | X | X | X | X | X | X |

Figure 7-72. SPI Data Register
Register Description

The SPI Data Register contains data received on the SPI port when read. Reading it empties the eight byte receive FIFO in PIO byte mode. This receive data is valid when the receive bit of the SPI Interrupt Value is set to '1' (RxIntVal triggers) or the Receive Data Ready bit of the SPI Control Register is set to '1'. Writing to this register in PIO byte mode will initiate a transfer of data, the number of bits defined by Transmit Bit Length field in the SPI Control Register.

Data (Bits [7:0])

The Data field contains data received or to be transmitted on the SPI port.

Reserved

All reserved bits should be written as '0'.

7.10.9 SPI Transmit Address Register [0xC0D8] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-73. SPI Transmit Address Register
Register Description

The SPI Transmit Address Register is used as the base address for the SPI transmit DMA.

Address (Bits [15:0])

The Address field sets the base address for the SPI transmit DMA.

7.10.10 SPI Transmit Count Register [0xC0DA] [R/W]

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|----------|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | Count... | | |
| Read/Write | - | - | - | - | - | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-74. SPI Transmit Count Register

Register Description

The SPI Transmit Count Register designates the block byte length for the SPI transmit DMA transfer.

Count (Bits [10:0])

The Count field sets the count for the SPI transmit DMA transfer.

Reserved

All reserved bits should be written as '0'.

7.10.11 SPI Receive Address Register [0xC0DC] [R/W]

| | | | | | | | | |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Address... | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Address | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-75. SPI Receive Address Register

Register Description

The SPI Receive Address Register is issued as the base address for the SPI Receive DMA.

Address (Bits [15:0])

The Address field sets the base address for the SPI receive DMA.

7.10.12 SPI Receive Count Register [0xC0DE] [R/W]

| | | | | | | | | |
|------------|----------|-----|-----|-----|-----|----------|-----|-----|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | Count... | | |
| Read/Write | - | - | - | - | - | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Count | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-76. SPI Receive Count Register

Register Description

The SPI Receive Count Register designates the block byte length for the SPI receive DMA transfer.

Count (Bits [10:0])

The Count field sets the count for the SPI receive DMA transfer.

Reserved

All reserved bits should be written as '0'.

7.11 UART Registers

There are three registers dedicated to UART operation. Each of these registers is covered in this section and summarized in Figure 7-77.

| Register Name | Address | R/W |
|-----------------------|---------|-----|
| UART Control Register | 0xC0E0 | R/W |
| UART Status Register | 0xC0E2 | R |
| UART Data Register | 0xC0E4 | R/W |

Figure 7-77. UART Registers

7.11.1 UART Control Register [0xC0E0] [R/W]

| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|------------|-------------|----|----|----|----|----|---|---|
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|-------------|---|---|--------------|-------------|-----|-----|-------------|
| Field | ...Reserved | | | Scale Select | Baud Select | | | UART Enable |
| Read/Write | - | - | - | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |

Figure 7-78. UART Control Register

Register Description

The UART Control Register enables or disables the UART allowing GPIO7 (UART_TXD) and GPIO6 (UART_RXD) to be freed up for general use. This register must also be written to set the baud rate, which is based on a 48-MHz clock.

Scale Select (Bit 4)

The Scale Select bit acts as a prescaler that will divide the baud rate by eight.

1: Enable prescaler

0: Disable prescaler

Baud Select (Bits [3:1])

Please refer to *Table 7-11* for a definition of this field.

Table 7-11. UART Baud Select Definition

| Baud Select [3:1] | Baud Rate w/ DIV8 = 0 | Baud Rate w/ DIV8 = 1 |
|-------------------|-----------------------|-----------------------|
| 000 | 115.2 KBaud | 14.4 KBaud |
| 001 | 57.6 KBaud | 7.2 KBaud |
| 010 | 38.4 KBaud | 4.8 KBaud |
| 011 | 28.8 KBaud | 3.6 KBaud |
| 100 | 19.2 KBaud | 2.4 KBaud |
| 101 | 14.4 KBaud | 1.8 KBaud |
| 110 | 9.6 KBaud | 1.2 KBaud |
| 111 | 7.2 KBaud | 0.9 KBaud |

UART Enable (Bit 0)

The UART Enable bit enables or disables the UART.

1: Enable UART

0: Disable UART. This allows GPIO6 and GPIO7 to be used for general use

Reserved

All reserved bits should be written as '0'.

7.11.2 UART Status Register [0xC0E2] [R]

| | | | | | | | | |
|------------|-------------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved... | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|-------------|---|---|---|---|---|--------------|---------------|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | ...Reserved | | | | | | Receive Full | Transmit Full |
| Read/Write | - | - | - | - | - | - | R | R |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-79. UART Status Register
Register Description

The UART Status Register is a read-only register that indicates the status of the UART buffer.

Receive Full (Bit 1)

The Receive Full bit indicates whether the receive buffer is full. It can be programmed to interrupt the CPU as interrupt #5 when the buffer is full. This can be done through the UART bit of the Interrupt Enable Register (0xC00E). This bit will automatically be cleared when data is read from the UART Data Register.

1: Receive buffer full

0: Receive buffer empty

Transmit Full (Bit 0)

The Transmit Full bit indicates whether the transmit buffer is full or not. It can be programmed to interrupt the CPU as interrupt #4 when the buffer is empty. This can be done through the UART bit of the Interrupt Enable Register (0xC00E). This bit will automatically be set to '1' after data is written by EZ-Host to the UART Data Register (to be transmitted). This bit will automatically be cleared to '0' after the data is transmitted.

1: Transmit buffer full (transmit busy)

0: Transmit buffer is empty and ready for a new byte of data

7.11.3 UART Data Register [0xC0E4] [R/W]

| | | | | | | | | |
|------------|----------|----|----|----|----|----|---|---|
| Bit # | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Field | Reserved | | | | | | | |
| Read/Write | - | - | - | - | - | - | - | - |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|------------|------|-----|-----|-----|-----|-----|-----|-----|
| Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Field | Data | | | | | | | |
| Read/Write | R/W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-80. UART Data Register
Register Description

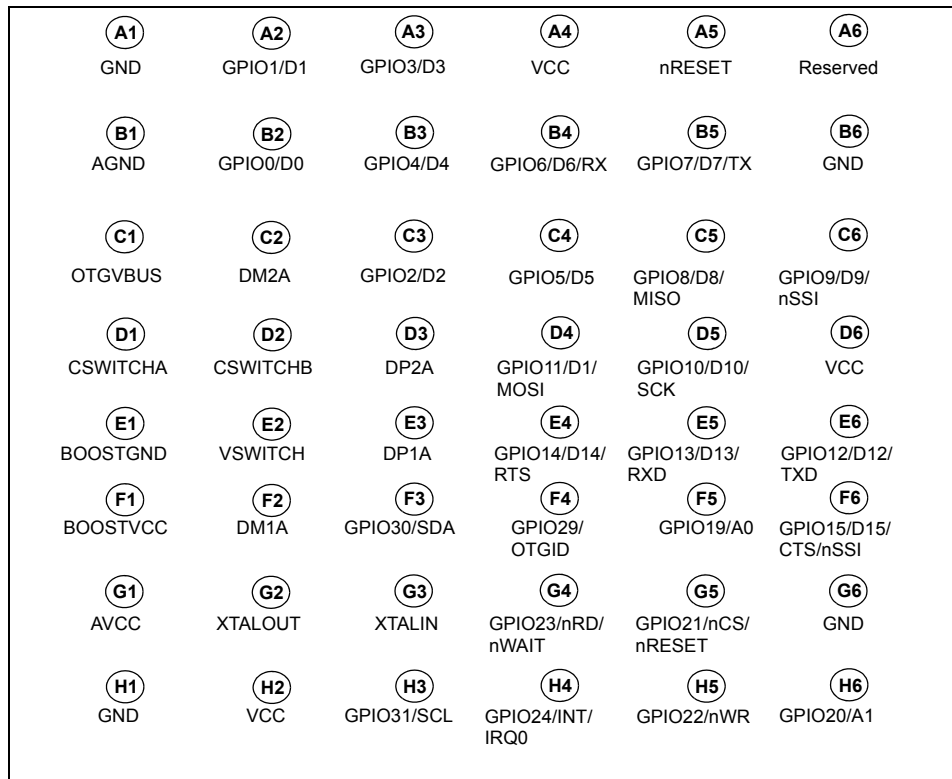
The UART Data Register contains data to be transmitted or received from the UART port. Data written to this register will start a data transmission and also causes the UART Transmit Empty Flag of the UART Status Register to set. When data received on the UART port is read from this register, the UART Receive Full Flag of the UART Status Register will get cleared.

Data (Bits [7:0])

The Data field is where the UART data to be transmitted or received is located

Reserved

All reserved bits should be written as '0'.

8.0 Pin Diagram
CY7C67200 48-pin FBGA

Figure 8-1. EZ-OTG Pin Diagram

9.0 Pin Descriptions

Table 9-1. Pin Descriptions

| Pin | Name | Type | Description |
|-----|-------------------------|------|---|
| H3 | GPIO31/SCK | I/O | GPIO31: General Purpose I/O SCK: I2C EEPROM SCK |
| F3 | GPIO30/SDA | I/O | GPIO30: General Purpose I/O SDA: I2C EEPROM SDA |
| F4 | GPIO29/OTGID | I/O | GPIO29: General Purpose I/O OTGID: Input for OTG ID pin. When used as OTGID, this pin should be tied high through an external pull-up resistor. Assuming $V_{CC} = 3.0V$, a 10K to 40K resistor should be used. |
| H4 | GPIO24/INT/IRQ0 | I/O | GPIO24: General Purpose I/O INT: HPI INT IRQ0: Interrupt Request 0. See Register 0xC006. This pin is also one of two possible GPIO wakeup sources. |
| G4 | GPIO23/nRD | I/O | GPIO23: General Purpose I/O nRD: HPI nRD |
| H5 | GPIO22/nWR | I/O | GPIO22: General Purpose I/O nWR: HPI nWR |
| G5 | GPIO21/nCS | I/O | GPIO21: General Purpose I/O nCS: HPI nCS |
| H6 | GPIO20/A1 | I/O | GPIO20: General Purpose I/O A1: HPI A1 |
| F5 | GPIO19/A0 | I/O | GPIO19: General Purpose I/O A0: HPI A0 |
| F6 | GPIO15/D15/CTS/ nSSI | I/O | GPIO15: General Purpose I/O D15: D15 for HPI CTS: HSS CTS nSSI: SPI nSSI |
| E4 | GPIO14/D14/RTS | I/O | GPIO14: General Purpose I/O D14: D14 for HPI RTS: HSS RTS |
| E5 | GPIO13/D13/RXD | I/O | GPIO13: General Purpose I/O D13: D13 for HPI RXD: HSS RXD (Data is received on this pin) |
| E6 | GPIO12/D12/TXD | I/O | GPIO12: General Purpose I/O D12: D12 for HPI TXD: HSS TXD (Data is transmitted from this pin) |
| D4 | GPIO11/D11/MOSI | I/O | GPIO11: General Purpose I/O D11: D11 for HPI MOSI: SPI MOSI |
| D5 | GPIO10/D10/SCK | I/O | GPIO10: General Purpose I/O D10: D10 for HPI SCK: SPI SCK |
| C6 | GPIO9/D9/nSSI | I/O | GPIO9: General Purpose I/O D9: D9 for HPI nSSI: SPI nSSI |
| C5 | GPIO8/D8/MISO | I/O | GPIO8: General Purpose I/O D8: D8 for HPI MISO: SPI MISO |
| B5 | GPIO7/D7/TX | I/O | GPIO7: General Purpose I/O D7: D7 for HPI TX: UART TX (Data is transmitted from this pin) |
| B4 | GPIO6/D6/RX | I/O | GPIO6: General Purpose I/O D6: D6 for HPI RX: UART RX (Data is received on this pin) |

Table 9-1. Pin Descriptions (continued)

| Pin | Name | Type | Description |
|----------------|----------------------|---------------|---|
| C4 | GPIO5/D5 | I/O | GPIO5: General Purpose I/O D5: D5 for HPI |
| B3 | GPIO4/D4 | I/O | GPIO4: General Purpose I/O D4: D4 for HPI |
| A3 | GPIO3/D3 | I/O | GPIO3: General Purpose I/O D3: D3 for HPI |
| C3 | GPIO2/D2 | I/O | GPIO2: General Purpose I/O D2: D2 for HPI |
| A2 | GPIO1/D1 | I/O | GPIO1: General Purpose I/O D1: D1 for HPI |
| B2 | GPIO0/D0 | I/O | GPIO0: General Purpose I/O D0: D0 for HPI |
| F2 | DM1A | I/O | USB Port 1A D– |
| E3 | DP1A | I/O | USB Port 1A D+ |
| C2 | DM2A | I/O | USB Port 2A D– |
| D3 | DP2A | I/O | USB Port 2A D+ |
| G3 | XTALIN | Input | Crystal Input or Direct Clock Input |
| G2 | XTALOUT | Output | Crystal output. Leave floating if direct clock source is used. |
| A5 | nRESET | Input | Reset |
| A6 | Reserved | – | Tie to Gnd for normal operation. |
| F1 | BOOSTV _{CC} | Power | Booster Power Input: 2.7V to 3.6V |
| E2 | VSWITCH | Analog Output | Booster Switching Output |
| E1 | BOOSTGND | Ground | Booster Ground |
| C1 | OTGVBUS | Analog I/O | USB OTG Vbus |
| D1 | CSWITCHA | Analog | Charge Pump Capacitor |
| D2 | CSWITCHB | Analog | Charge Pump Capacitor |
| G1 | AV _{CC} | Power | USB Power |
| B1 | AGND | Ground | USB Ground |
| H2, D6, A4 | V _{CC} | Power | Main Vcc |
| G6, B6, A1, H1 | GND | Ground | Main Ground |

10.0 Absolute Maximum Ratings

This section lists the absolute maximum ratings. Stresses above those listed can cause permanent damage to the device. Exposure to maximum rated conditions for extended periods can affect device operation and reliability.

Storage Temperature –40°C to +125°C

Ambient Temperature with Power Supplied .. –40°C to +85°C

Supply Voltage to Ground Potential 0.0V to +3.6V

DC Input Voltage to Any General Purpose Input Pin 5.5V

DC Voltage Applied to XTALIN –0.5V to V_{CC} + 0.5V

Static Discharge Voltage > 2000V

Max Output Current, per I/O..... 4 mA

11.0 Operating Conditions

T_A (Ambient Temperature Under Bias) –40°C to +85°C

Supply Voltage (V_{CC}, AV_{CC}) +3.0V to +3.6V

Supply Voltage (BoostV_{CC})^[5]..... +2.7V to +3.6V

Ground Voltage 0V

F_{OSC} (Oscillator or Crystal Frequency) 12 MHz ± 500 ppm

..... Parallel Resonant

Note:

5. The on-chip voltage booster circuit boosts BoostV_{CC} to provide a nominal 3.3V V_{CC} supply.

12.0 Crystal Requirements (XTALIN, XTALOUT)

Table 12-1. Crystal Requirements

| Crystal Requirements, (XTALIN, XTALOUT) | Min. | Typical | Max. | Unit |
|---|------|---------|------|------|
| Parallel Resonant Frequency | | 12 | | MHz |
| Frequency Stability | -500 | | +500 | PPM |
| Load Capacitance | 20 | | 33 | pF |
| Driver Level | | | 500 | μW |
| Start-up Time | | | 5 | ms |
| Mode of Vibration: Fundamental | | | | |

13.0 DC Characteristics

Table 13-1. DC Characteristics^[6]

| Parameter | Description | Conditions | Min. | Typ. | Max. | Unit |
|----------------------|-------------------------------------|--|-------|------|-------|------|
| V_{CC} , AV_{CC} | Supply Voltage | | 3.0 | 3.3 | 3.6 | V |
| $BoosV_{CC}$ | Supply Voltage | | 2.7 | | 3.6 | V |
| V_{IH} | Input HIGH Voltage | | 2.0 | | 5.5 | V |
| V_{IL} | Input LOW Voltage | | | | 0.8 | V |
| I_I | Input Leakage Current | $0 < V_{IN} < V_{CC}$ | -10.0 | | +10.0 | μA |
| V_{OH} | Output Voltage HIGH | $I_{OUT} = 4 \text{ mA}$ | 2.4 | | | V |
| V_{OL} | Output Voltage LOW | $I_{OUT} = -4 \text{ mA}$ | | | 0.4 | V |
| I_{OH} | Output Current HIGH | | | | 4 | mA |
| I_{OL} | Output Current LOW | | | | 4 | mA |
| C_{IN} | Input Pin Capacitance | Except D+/D- | | | 10 | pF |
| | | D+/D- | | | 15 | pF |
| V_{HYS} | Hysteresis on nReset Pin | | 250 | | | mV |
| $I_{CC}^{[7, 8]}$ | Supply Current | 2 transceivers powered | | 80 | 100 | mA |
| $I_{CCB}^{[7, 8]}$ | Supply Current with Booster Enabled | 2 transceivers powered | | 135 | 180 | mA |
| I_{SLEEP} | Sleep Current | USB Peripheral: includes 1.5K internal pull-up | | 210 | 500 | μA |
| | | Without 1.5K internal pull-up | | 5 | 30 | μA |
| I_{SLEEPB} | Sleep Current with Booster Enabled | USB Peripheral: includes 1.5K internal pull-up | | 210 | 500 | μA |
| | | Without 1.5K internal pull-up | | 5 | 30 | μA |

Table 13-2. DC Characteristics: Charge Pump

| Parameter | Description | Conditions | Min. | Typ. | Max. | Unit |
|----------------------|----------------------------|---|------|------|------|------|
| $V_{A_VBUS_OUT}$ | Regulated OTGVBUS Voltage | $8 \text{ mA} < I_{LOAD} < 10 \text{ mA}$ | 4.4 | | 5.25 | V |
| $T_{A_VBUS_RISE}$ | V_{BUS} Rise Time | $I_{LOAD} = 10 \text{ mA}$ | | | 100 | ms |
| $I_{A_VBUS_OUT}$ | Maximum Load Current | | 8 | | 10 | mA |
| C_{DRD_VBUS} | OUTVBUS Bypass Capacitance | $4.4\text{V} < V_{BUS} < 5.25\text{V}$ | 1.0 | | 6.5 | pF |
| $V_{A_VBUS_LKG}$ | OTGVBUS Leakage Voltage | OTGVBUS not driven | | | 200 | mV |
| $V_{DRD_DATA_LKG}$ | Dataline Leakage Voltage | | | | 342 | mV |

Notes:

6. All tests were conducted with Charge pump off.
7. I_{CC} and I_{CCB} values are the same regardless of USB host or peripheral configuration.
8. There is no appreciable difference in I_{CC} and I_{CCB} values when only one transceiver is powered.

Table 13-2. DC Characteristics: Charge Pump (continued)

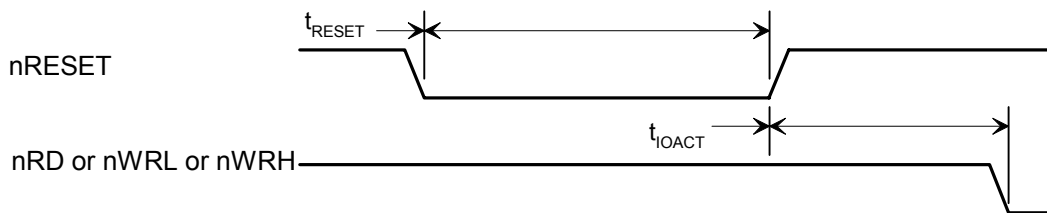
| Parameter | Description | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------|--|---|-------|------|------|------------|
| I_{CHARGE} | Charge Pump Current Draw | $I_{\text{LOAD}} = 8 \text{ mA}$ | | 20 | 20 | mA |
| | | $I_{\text{LOAD}} = 0 \text{ mA}$ | | 0 | 1 | mA |
| $I_{\text{CHARGE B}}$ | Charge Pump Current Draw with Booster Active | $I_{\text{LOAD}} = 8 \text{ mA}$ | | 30 | 45 | mA |
| | | $I_{\text{LOAD}} = 0 \text{ mA}$ | | 0 | 5 | mA |
| $I_{\text{B_DSCHG_IN}}$ | B-Device (SRP Capable) Discharge Current | $0\text{V} < V_{\text{BUS}} < 5.25\text{V}$ | | | 8 | mA |
| $V_{\text{A_VBUS_VALID}}$ | A-Device VBUS Valid | | 4.4 | | | V |
| $V_{\text{A_SESS_VALID}}$ | A-Device Session Valid | | 0.8 | | 2.0 | V |
| $V_{\text{B_SESS_VALID}}$ | B-Device Session Valid | | 0.8 | | 4.0 | V |
| $V_{\text{A_SESS_END}}$ | B-Device Session End | | 0.2 | | 0.8 | V |
| E | Efficiency When Loaded | $I_{\text{LOAD}} = 8 \text{ mA}, V_{\text{CC}} = 3.3\text{V}$ | | 75 | | % |
| R_{PD} | Data Line Pull-down | | 14.25 | | 24.8 | Ω |
| $R_{\text{A_BUS_IN}}$ | A-device V_{BUS} Input Impedance to GND | V_{BUS} is not being driven | 40 | | 100 | k Ω |
| $R_{\text{B_SRP_UP}}$ | B-device V_{BUS} SRP Pull-up | Pull-up voltage = 3.0V | 281 | | | Ω |
| $R_{\text{B_SRP_DWN}}$ | B-device V_{BUS} SRP Pull-down | | 656 | | | Ω |

13.1 USB Transceiver

USB 2.0-compatible in full- and low-speed modes.

14.0 AC Timing Characteristics

14.1 Reset Timing

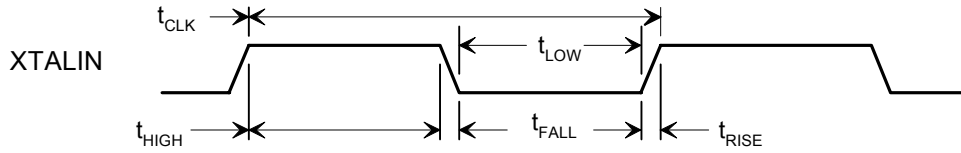


Reset Timing

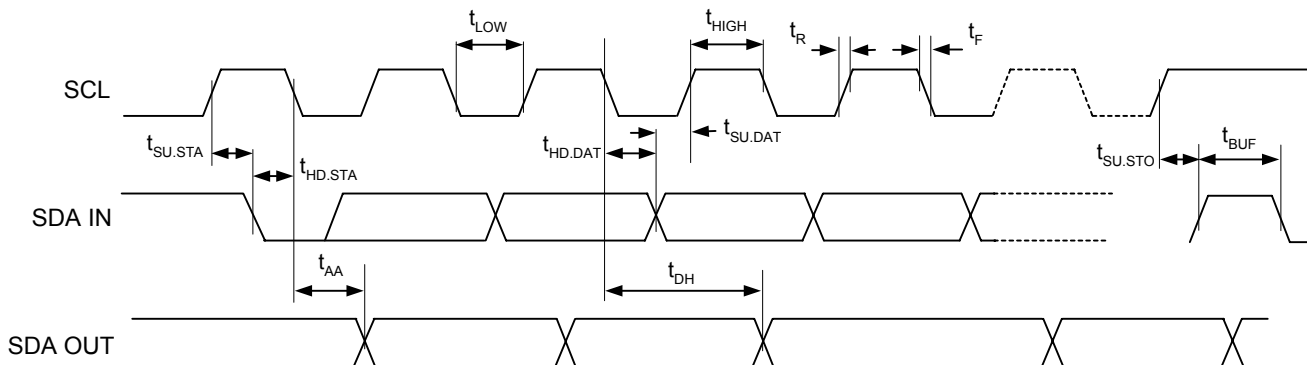
| Parameter | Description | Min. | Typ. | Max. | Unit |
|--------------------|-----------------------------------|------|------|------|-----------------------|
| t_{RESET} | nRESET pulse width | 16 | | | clocks ^[9] |
| t_{IOACT} | nRESET HIGH to nRD or nWRx active | 200 | | | μs |

Note:

9. Clock is 12 MHz nominal.

14.2 Clock Timing

Clock Timing

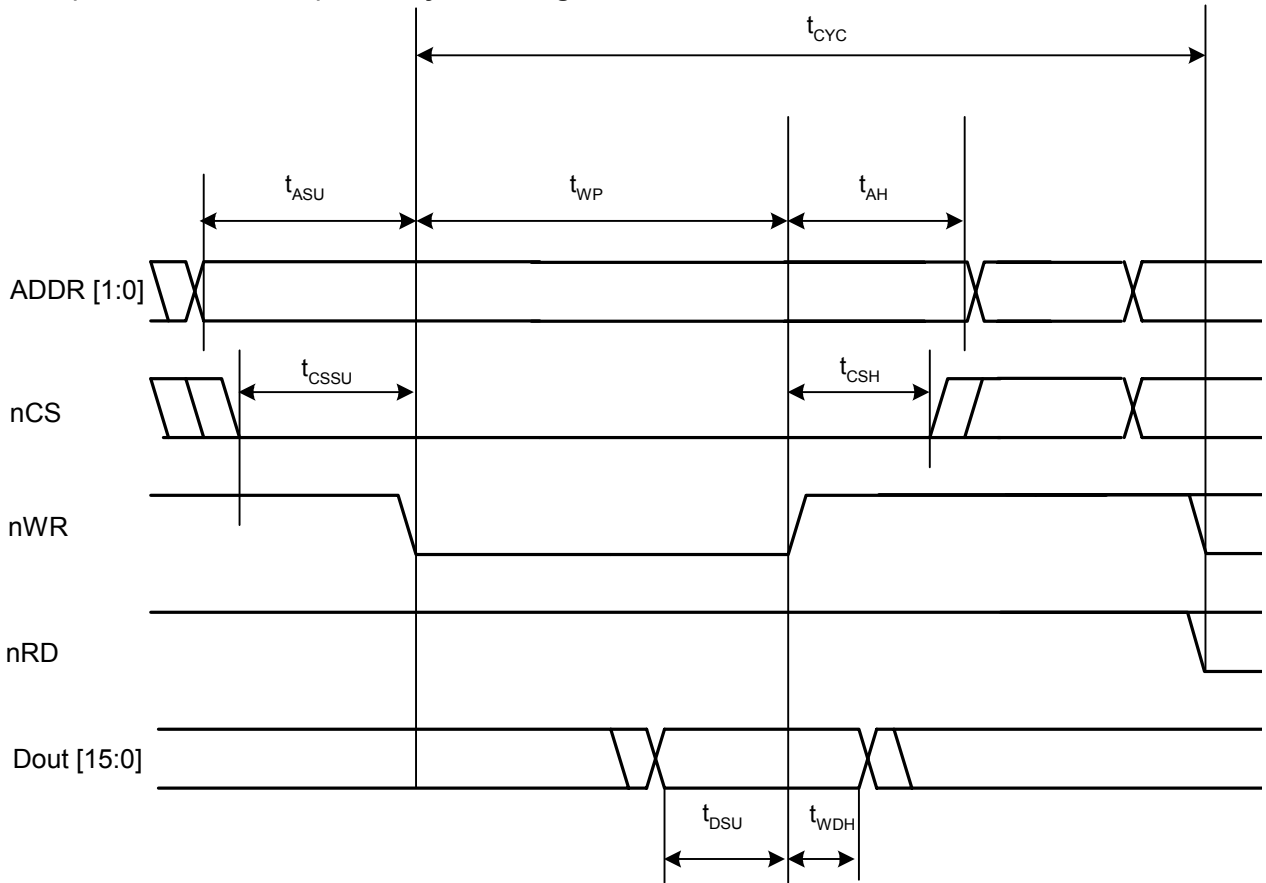
| Parameter | Description | Min. | Typ. | Max. | Unit |
|-------------------|--|-------|-------|------|------|
| f_{CLK} | Clock frequency | | 12.0 | | MHz |
| $V_{XINH}^{[10]}$ | Clock input high (XTALOUT left floating) | 1.5 | 3.0 | 3.6 | V |
| t_{CLK} | Clock period | 83.17 | 83.33 | 83.5 | ns |
| t_{HIGH} | Clock high time | 36 | | 44 | ns |
| t_{LOW} | Clock low time | 36 | | 44 | ns |
| t_{RISE} | Clock rise time | | | 5.0 | ns |
| t_{FALL} | Clock fall time | | | 5.0 | ns |
| Duty Cycle | | 45 | | 55 | % |

14.3 I2C EEPROM Timing
1. I2C EEPROM Bus Timing - Serial I/O


| Parameter | Description | Min. | Typical | Max. | Unit |
|--------------|----------------------------------|------|---------|------|------|
| f_{SCL} | Clock Frequency | | | 400 | kHz |
| t_{LOW} | Clock Pulse Width Low | 1300 | | | ns |
| t_{HIGH} | Clock Pulse Width High | 600 | | | ns |
| t_{AA} | Clock Low to Data Out Valid | 900 | | | ns |
| t_{BUF} | Bus Idle Before New Transmission | 1300 | | | ns |
| $t_{HD.STA}$ | Start Hold Time | 600 | | | ns |
| $t_{SU.STA}$ | Start Set-up Time | 600 | | | ns |
| $t_{HD.DAT}$ | Data In Hold Time | 0 | | | ns |
| $t_{SU.DAT}$ | Data In Set-up Time | 100 | | | ns |
| t_R | Input Rise Time | | | 300 | ns |
| t_F | Input Fall Time | | | 300 | ns |
| $t_{SU.STO}$ | Stop Set-up Time | 600 | | | ns |
| t_{DH} | Data Out Hold Time | 0 | | | ns |

Note:

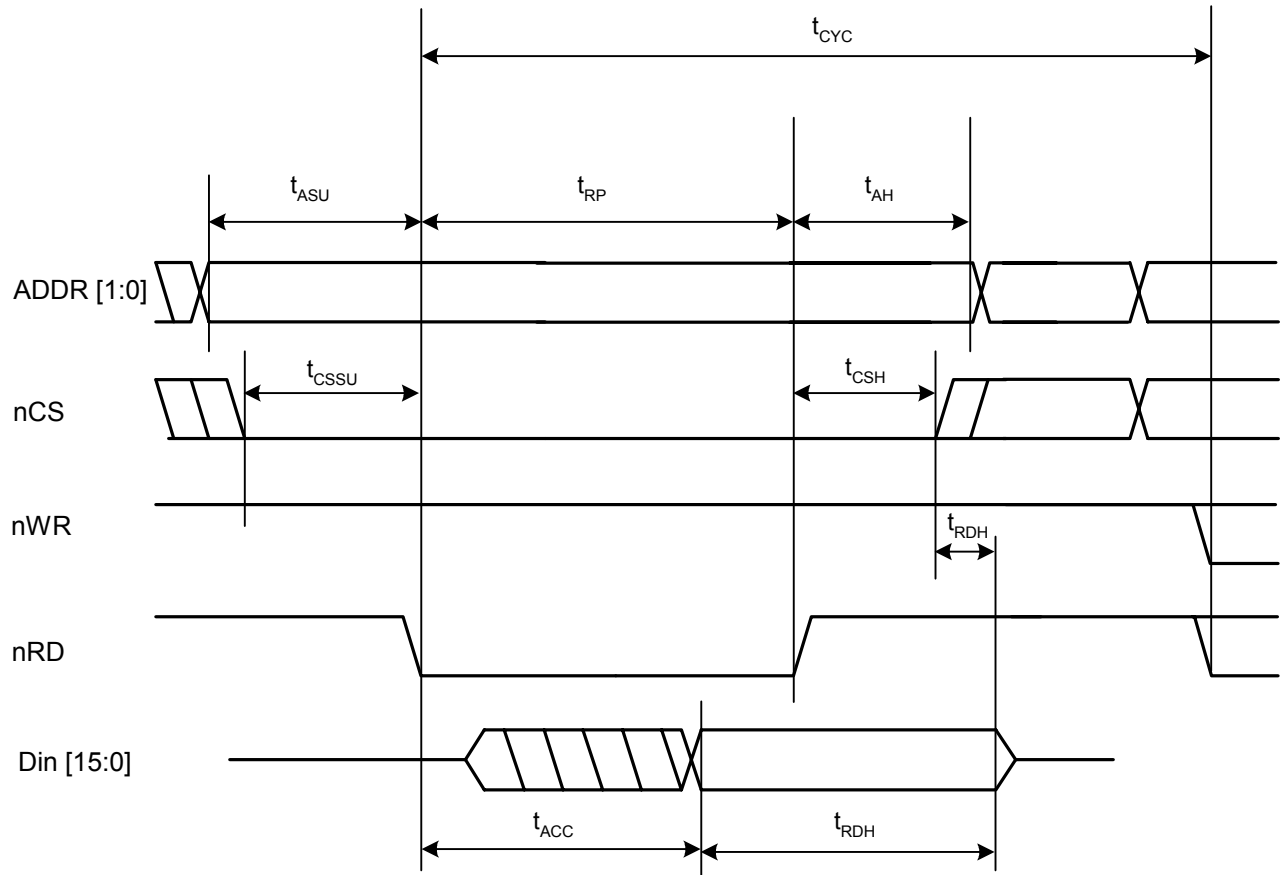
10. V_{XINH} is required to be 3.0 V to obtain an internal 50/50 duty cycle clock.

14.4 HPI (Host Port Interface) Write Cycle Timing


| Parameter | Description | Min. | Typical | Max. | Unit |
|------------|--------------------|------|---------|------|------------|
| t_{ASU} | Address set-up | -1 | | | ns |
| t_{AH} | Address hold | -1 | | | ns |
| t_{CSSU} | Chip select set-up | -1 | | | ns |
| t_{CSH} | Chip select hold | -1 | | | ns |
| t_{DSU} | Data set-up | 6 | | | ns |
| t_{WDH} | Write data hold | 2 | | | ns |
| t_{WP} | Write pulse width | 2 | | | $T^{[11]}$ |
| t_{CYC} | Write cycle time | 6 | | | $T^{[11]}$ |

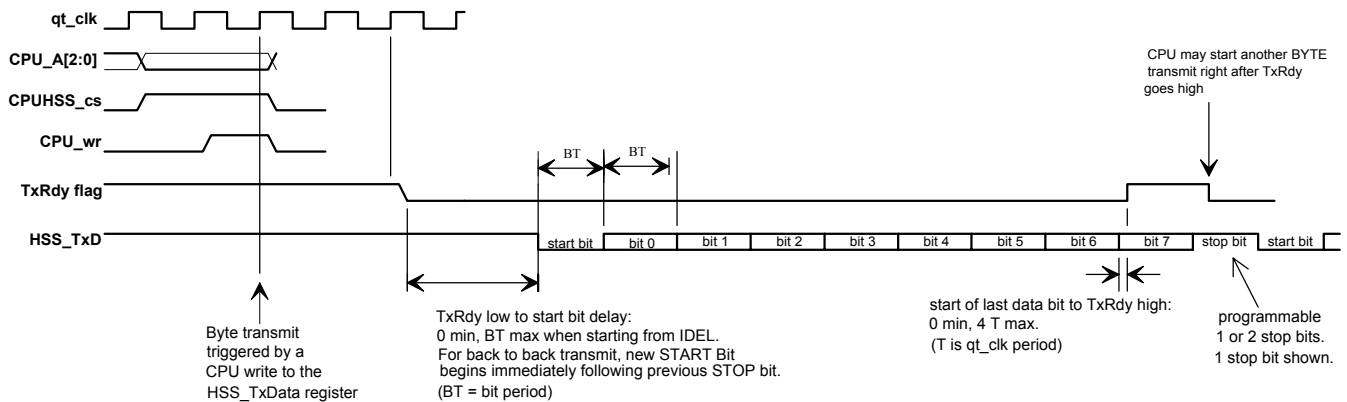
Note:

 11. T = system clock period = 1/48 MHz.

14.5 HPI (Host Port Interface) Read Cycle Timing


| Parameter | Description | Min. | Typ. | Max. | Unit |
|------------|---|------|------|------|--------------|
| t_{ASU} | Address set-up | -1 | | | ns |
| t_{AH} | Address hold | -1 | | | ns |
| t_{CSSU} | Chip select set-up | -1 | | | ns |
| t_{CSH} | Chip select hold | -1 | | | ns |
| t_{ACC} | Data access time, from HPI_nRD falling | | | 1 | $\tau^{[1]}$ |
| t_{RDH} | Read data hold, relative to the earlier of HPI_nRD rising or HPI_nCS rising | 0 | | 7 | ns |
| t_{RP} | Read pulse width | 2 | | | $\tau^{[1]}$ |
| t_{CYC} | Read cycle time | 6 | | | $\tau^{[1]}$ |

14.6 HSS BYTE Mode Transmit

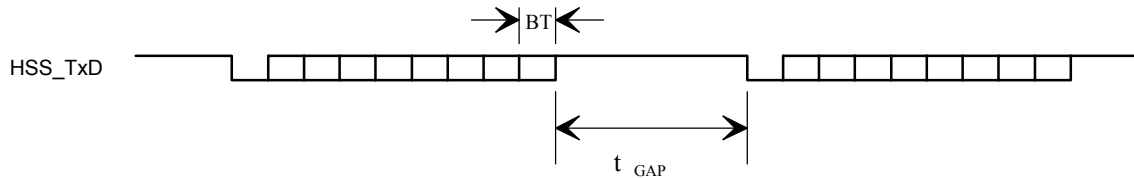


qt_clk, CPU_A, CPUHSS_cs, CPU_wr are internal signals, included in the diagram to illustrate relationship between CPU operations and HSS port operations.

Bit 0 is LSB of data byte. Data bits are HIGH true: HSS_TxD HIGH = data bit value '1'.

BT = bit time = 1/ baud rate.

14.7 HSS Block Mode Transmit



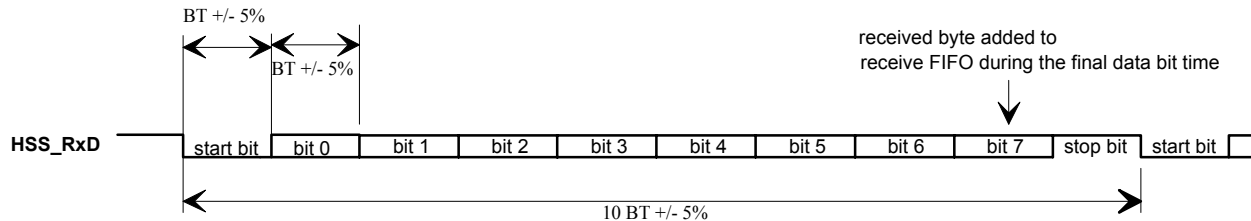
BLOCK mode transmit timing is similar to BYTE mode, except the STOP bit time is controlled by the HSS_GAP value.

The BLOCK mode STOP bit time, $t_{GAP} = (HSS_GAP - 9) BT$, where BT is the bit time, and HSS_GAP is the content of the HSS Transmit Gap Register 90xC074].

The default t_{GAP} is 2 BT.

BT = bit time = 1/ baud rate.

14.8 HSS BYTE and BLOCK Mode Receive



Receive data arrives asynchronously relative to the internal clock.

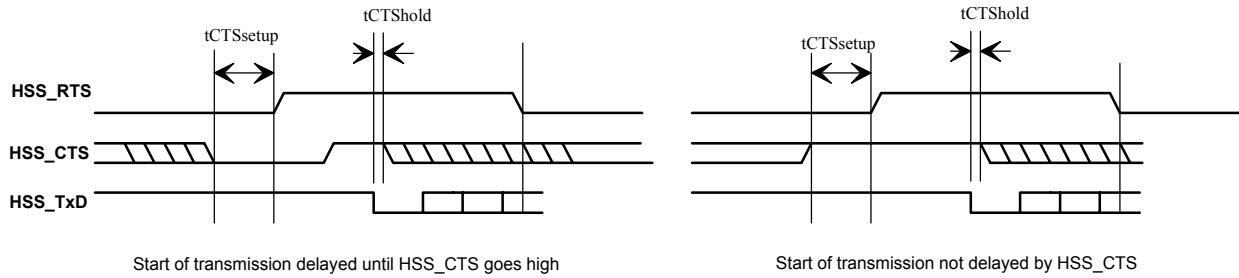
Incoming data bit rate may deviate from the programmed baud rate clock by as much as $\pm 5\%$ (with HSS_RATE value of 23 or higher).

BYTE mode received bytes are buffered in a FIFO. The FIFO not empty condition becomes the RxRdy flag.

BLOCK mode received bytes are written directly to the memory system.

Bit 0 is LSB of data byte. Data bits are HIGH true: HSS_RxD HIGH = data bit value '1'.

BT = bit time = 1/ baud rate.

14.9 Hardware CTS/RTS Handshake


$t_{CTS\text{set-up}}$: HSS_CTS set-up time before HSS_RTS = 1.5T min.

$t_{CTS\text{hold}}$: HSS_CTS hold time after START bit = 0 ns min.

T = 1/48 MHz.

When RTS/CTS hardware handshake is enabled, transmission can be held off by deasserting HSS_CTS at least 1.5T before HSS_RTS. Transmission resumes when HSS_CTS returns HIGH. HSS_CTS must remain HIGH until START bit.

HSS_RTS is deasserted in the third data bit time.

An application may choose to hold HSS_CTS until HSS_RTS is deasserted, which always occurs after the START bit.

15.0 Register Summary

Table 15-1. Register Summary

| R/W | Address | Register | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Default High | | | | |
|-----|------------------------|----------------------------------|----------------------------|-----------------------------|------------------------------|---------------------------|-------------------------|------------------------|-----------------------------|--------------------------------|--------------------------------|---------------|------------|-----------|-----------|
| | | | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Default Low | | | | |
| R | 0x0140 | HPI Breakpoint | Address... ...Address | | | | | | | | 0000 0000 | | | | |
| R | 0x0142 | Interrupt Routing | VBUS to HPI Enable | ID to HPI Enable | SOF/EOP2 to HPI Enable | SOF/EOP2 to CPU Enable | SOF/EOP1 to HPI Enable | SOF/EOP1 to CPU Enable | Reset2 to HPI Enable | HPI Swap 1 Enable | 0001 0100 | | | | |
| | | | Resume2 to HPI Enable | Resume1 to HPI Enable | Reserved | | Done2 to HPI Enable | Done1 to HPI Enable | Reset1 to HPI Enable | HPI Swap 0 Enable | 0000 0000 | | | | |
| W | 1: 0x0144 2: 0x0148 | SIEXmsg | Data... ...Data | | | | | | | | xxxx xxxx | | | | |
| R/W | 0x02n0 | Device n Endpoint n Control | Reserved | | | | | | | | xxxx xxxx | | | | |
| | | | IN/OUT Ignore Enable | Sequence Select | Stall Enable | ISO Enable | NAK Interrupt Enable | Direction Select | Enable | ARM Enable | xxxx xxxx | | | | |
| R/W | 0x02n2 | Device n Endpoint n Address | Address... ...Address | | | | | | | | xxxx xxxx | | | | |
| R/W | 0x02n4 | Device n Endpoint n Count | Reserved | | | | | | Count... | xxxx xxxx | | | | | |
| R/W | 0x02n6 | Device n Endpoint n Status | Reserved | | | | Overflow Flag | Underflow Flag | OUT Exception Flag | IN Exception Flag | xxxx xxxx | | | | |
| | | | Stall Flag | NAK Flag | Length Exception Flag | Set-up Flag | Sequence Status | Timeout Flag | Error Flag | ACK Flag | xxxx xxxx | | | | |
| R/W | 0x02n8 | Device n Endpoint n Count Result | Result... ...Result | | | | | | | | xxxx xxxx | | | | |
| R | 0xC000 | CPU Flags | Reserved... | | | | Global Interrupt Enable | | | | Negative Flag | Overflow Flag | Carry Flag | Zero Flag | 0000 0000 |
| R/W | 0xC002 | Bank | Address... ...Address | | | | | | | | 0000 0001 | | | | |
| R | 0xC004 | Hardware Revision | Revision... ...Revision | | | | | | | | xxxx xxxx | | | | |
| R/W | 0xC006 | GPIO Control | Write Protect Enable | UD | Reserved | | SAS Enable | Mode Select | | 0000 0000 | | | | | |
| | | | HSS Enable | Reserved | SPI Enable | Reserved | | | Interrupt 0 Polarity Select | Interrupt 0 Enable | 0000 0000 | | | | |
| R/W | 0xC008 | CPU Speed | Reserved... | | | | | | CPU Speed | | | | 0000 0000 | | |
| R/W | 0xC00A | Power Control | Reserved | Host/Device 2 Wake Enable | Reserved | Host/Device 1 Wake Enable | OTG Wake Enable | Reserved | HSS Wake Enable | SPI Wake Enable | 0000 0000 | | | | |
| | | | HPI Wake Enable | Reserved | GPI Wake Enable | | Reserved | Boost 3V OK | Sleep Enable | Halt Enable | 0000 0000 | | | | |
| R/W | 0xC00C | Watchdog Timer | Reserved... | | | | | | | | 0000 0000 | | | | |
| | | | ...Reserved | | Timeout Flag | Period Select | Lock Enable | | WDT Enable | Reset Strobe | 0000 0000 | | | | |
| R/W | 0xC00E | Interrupt Enable | Reserved | | | | OTG Interrupt Enable | SPI Interrupt Enable | Reserved | Host/Device 2 Interrupt Enable | Host/Device 1 Interrupt Enable | 0000 0000 | | | |
| | | | HSS Interrupt Enable | In Mailbox Interrupt Enable | Out Mailbox Interrupt Enable | Reserved | UART Interrupt Enable | GPIO Interrupt Enable | Timer 1 Interrupt Enable | Timer 0 Interrupt Enable | 0001 0000 | | | | |
| R/W | 0xC098 | OTG Control | Reserved | | VBUS Pull-up Enable | Receive Disable | Charge Pump Enable | VBUS Discharge Enable | D+ Pull-up Enable | D- Pull-up Enable | 0000 0000 | | | | |
| | | | D+ Pull-down Enable | D- Pull-down Enable | Reserved | | | OTG Data Status | ID Status | VBUS Valid Flag | 0000 0XXX | | | | |
| R/W | 0: 0xC010 1: 0xC012 | Timer n | Count... ...Count | | | | | | | | 1111 1111 | | | | |
| R/W | 0xC014 | Breakpoint | Address... ...Address | | | | | | | | 0000 0000 | | | | |
| R/W | 1: 0xC018 2: 0xC01A | Extended Page n Map | Address... ...Address | | | | | | | | 0000 0000 | | | | |
| R/W | 0xC01E | GPIO 0 Output Data | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 | 0000 0000 | | | | |
| | | | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 | 0000 0000 | | | | |
| R | 0xC020 | GPIO 0 Input Data | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 | 0000 0000 | | | | |
| | | | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 | 0000 0000 | | | | |
| R/W | 0xC022 | GPIO 0 Direction | GPIO15 | GPIO14 | GPIO13 | GPIO12 | GPIO11 | GPIO10 | GPIO9 | GPIO8 | 0000 0000 | | | | |
| | | | GPIO7 | GPIO6 | GPIO5 | GPIO4 | GPIO3 | GPIO2 | GPIO1 | GPIO0 | 0000 0000 | | | | |
| R/W | 0xC024 | GPIO 1 Output Data | GPIO31 | GPIO30 | GPIO29 | Reserved | | | | GPIO24 | 0000 0000 | | | | |
| | | | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | Reserved | | 0000 0000 | | | | | |

Table 15-1. Register Summary (continued)

| R/W | Address | Register | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Default High | |
|-----|------------------|---------------------------|------------------------------|------------------------------|-----------------------|--|----------------------|----------------------------------|---------------------------|--------------------------|------------------------|-----------|
| | | | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Default Low | |
| R | 0xC026 | GPIO 1 Input Data | GPIO31 | GPIO30 | GPIO29 | Reserved | | | GPIO24 | | 0000 0000 | |
| | | | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | Reserved | | | 0000 0000 | |
| R/W | 0xC028 | GPIO 1 Direction | GPIO31 | GPIO30 | GPIO29 | Reserved | | | GPIO24 | | 0000 0000 | |
| | | | GPIO23 | GPIO22 | GPIO21 | GPIO20 | GPIO19 | Reserved | | | 0000 0000 | |
| R/W | 0xC03C | USB Diagnostic | Reserved | Port 2A Diagnostic Enable | Reserved | Port 1A Diagnostic Enable | Reserved... | | | | 0000 0000 | |
| | | | ...Reserved | Pull-down Enable | LS Pull-up Enable | FS Pull-up Enable | Reserved | Force Select | | | 0000 0000 | |
| R/W | 0xC070 | HSS Control | HSS Enable | RTS Polarity Select | CTS Polarity Select | XOFF | XOFF Enable | CTS Enable | Receive Interrupt Enable | Done Interrupt Enable | 0000 0000 | |
| | | | Transmit Done Interrupt Flag | Receive Done Interrupt Flag | One Stop Bit | Transmit Ready | Packet Mode Select | Receive Overflow Flag | Receive Packet Ready Flag | Receive Ready Flag | 0000 0000 | |
| R/W | 0xC072 | HSS Baud Rate | Reserved | | | HSS Baud... | | | | | 0000 0000 | |
| | | | ...Baud | | | | | | | | 0001 0111 | |
| R/W | 0xC074 | HSS Transmit Gap | Reserved | | | | | | | | 0000 0000 | |
| | | | Transmit Gap Select | | | | | | | | 0000 1001 | |
| R/W | 0xC076 | HSS Data | Reserved | | | | | | | | xxxx xxxx | |
| | | | Data | | | | | | | | xxxx xxxx | |
| R/W | 0xC078 | HSS Receive Address | Address... | | | | | | | | 0000 0000 | |
| | | | ...Address | | | | | | | | 0000 0000 | |
| R/W | 0xC07A | HSS Receive Counter | Reserved | | | | | | Counter... | | 0000 0000 | |
| | | | ...Counter | | | | | | | | 0000 0000 | |
| R/W | 0xC07C | HSS Transmit Address | Address.. | | | | | | | | 0000 0000 | |
| | | | ...Address | | | | | | | | 0000 0000 | |
| R/W | 0xC07E | HSS Transmit Counter | Reserved | | | | | | Counter... | | 0000 0000 | |
| | | | ...Counter | | | | | | | | 0000 0000 | |
| R/W | 0xC080 0xC0A0 | Host n Control | Reserved | | | | | | | | 0000 0000 | |
| | | | Preamble Enable | Sequence Select | Sync Enable | ISO Enable | Reserved | | Arm Enable | | 0000 0000 | |
| R/W | 0xC082 0xC0A2 | Host n Address | Address... | | | | | | | | 0000 0000 | |
| | | | ...Address | | | | | | | | 0000 0000 | |
| R/W | 0xC084 0xC0A4 | Host n Count | Reserved | Port Select | Reserved | | | Count... | | | 0000 0000 | |
| | | | ...Count | | | | | | | | 0000 0000 | |
| R | 0xC086 0xC0A6 | Host n PID | Reserved | | | Overflow Flag | | Underflow Flag | Reserved | | 0000 0000 | |
| | | | Stall Flag | NAK Flag | Length Exception Flag | Reserved | Sequence Status | Timeout Flag | Error Flag | ACK Flag | 0000 0000 | |
| W | 0xC086 0xC0A4 | Host n EP Status | Reserved | | | | | | | | 0000 0000 | |
| | | | PID Select | | | Endpoint Select | | | | | 0000 0000 | |
| R | 0xC088 0xC0A8 | Host n Count Result | Result... | | | | | | | | 0000 0000 | |
| | | | ...Result | | | | | | | | 0000 0000 | |
| W | 0xC088 0xC0A8 | Host n Device Address | Reserved... | | | | | | | | 0000 0000 | |
| | | | ...Reserved | Address | | | | | | | | 0000 0000 |
| R/W | 0xC08A 0xC0AA | USB n Control | Reserved | | Port A D+ Status | Port A D- Status | Reserved | LOA | Mode Select | Reserved | xxxx 0000 | |
| | | | Port A Resistors Enable | Reserved | | Port A Force D+/- State | | Suspend Enable | Reserved | Port A SOF/EOP Enable | 0000 0000 | |
| R/W | 0xC08C | Host 1 Interrupt Enable | VBUS Interrupt Enable | ID Interrupt Enable | Reserved | | | SOF/EOP Interrupt Enable | Reserved | | 0000 0000 | |
| | | | Reserved | Port A Wake Interrupt Enable | Reserved | Port A Connect Change Interrupt Enable | Reserved | | Done Interrupt Enable | | 0000 0000 | |
| R/W | 0xC08C | Device 1 Interrupt Enable | VBUS Interrupt Enable | ID Interrupt Enable | Reserved | | | SOF/EOP Timeout Interrupt Enable | Reserved | SOF/EOP Interrupt Enable | Reset Interrupt Enable | 0000 0000 |
| | | | EP7 Interrupt Enable | EP6 Interrupt Enable | EP5 Interrupt Enable | EP4 Interrupt Enable | EP3 Interrupt Enable | EP2 Interrupt Enable | EP1 Interrupt Enable | EP0 Interrupt Enable | 0000 0000 | |
| R/W | 0xC08E 0xC0AE | Device n Address | Reserved... | | | | | | | | 0000 0000 | |
| | | | ...Reserved | Address | | | | | | | | 0000 0000 |
| R/W | 0xC090 | Host 1 Status | VBUS Interrupt Flag | ID Interrupt Flag | Reserved | | | SOF/EOP Interrupt Flag | Reserved | | xxxx xxxx | |
| | | | Reserved | Port A Wake Interrupt Flag | Reserved | Port A Connect Change Interrupt Flag | Reserved | Port A SE0 Status | Reserved | Done Interrupt Flag | xxxx xxxx | |

Table 15-1. Register Summary (continued)

| R/W | Address | Register | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Default High | |
|-----|------------------|---------------------------|----------------------|---------------------------------|----------------------|--|----------------------------------|-------------------------|--------------------------|---------------------------|---------------------------|-----------|
| | | | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Default Low | |
| R/W | 0xC090 | Device 1 Status | VBUS Interrupt Flag | ID Interrupt Flag | Reserved | | | | SOF/EOP Interrupt Flag | Reset Interrupt Flag | xxxx xxxx | |
| | | | EP7 Interrupt Flag | EP6 Interrupt Flag | EP5 Interrupt Flag | EP4 Interrupt Flag | EP3 Interrupt Flag | EP2 Interrupt Flag | EP1 Interrupt Flag | EP0 Interrupt Flag | xxxx xxxx | |
| R/W | 0xC092 0xC0B2 | Host n SOF/EOP Count | Reserved | | Count... | | | | | | 0010 1110 | |
| | | | ...Count | | | | | | | | 1110 0000 | |
| R | 0xC092 0xC0B2 | Device n Frame Number | SOF/EOP Timeout Flag | SOF/EOP Timeout Interrupt Count | | | Reserved | Frame... | | | 0000 0000 | |
| | | | ...Frame | | | | | | | | 0000 0000 | |
| R | 0xC094 0xC0B4 | Host n SOF/EOP Counter | Reserved | | Counter... | | | | | | | |
| | | | ...Counter | | | | | | | | | |
| W | 0xC094 0xC0B4 | Device n SOF/EOP Count | Reserved | | Count... | | | | | | | |
| | | | ...Count | | | | | | | | | |
| R | 0xC096 0xC0B6 | Host n Frame | Reserved | | | | | Frame... | | | 0000 0000 | |
| | | | ...Frame | | | | | | | | 0000 0000 | |
| R/W | 0xC0AC | Host 2 Interrupt Enable | Reserved | | | | | | SOF/EOP Interrupt Enable | Reserved | 0000 0000 | |
| | | | Reserved | Port A Wake Interrupt Enable | Reserved | Port A Connect Change Interrupt Enable | Reserved | | Done Interrupt Enable | 0000 0000 | | |
| R/W | 0xC0AC | Device 2 Interrupt Enable | Reserved | | | | SOF/EOP Timeout Interrupt Enable | Wake Interrupt Enable | SOF/EOP Interrupt Enable | Reset Interrupt Enable | 0000 0000 | |
| | | | EP7 Interrupt Enable | EP6 Interrupt Enable | EP5 Interrupt Enable | EP4 Interrupt Enable | EP3 Interrupt Enable | EP2 Interrupt Enable | EP1 Interrupt Enable | EP0 Interrupt Enable | 0000 0000 | |
| R/W | 0xC0B0 | Host 2 Status | Reserved | | | | | SOF/EOP Interrupt Flag | Reserved | xxxx xxxx | | |
| | | | Reserved | Port A Wake Interrupt Flag | Reserved | Port A Connect Change Interrupt Flag | Reserved | Port A SE0 Status | Done Interrupt Flag | xxxx xxxx | | |
| R/W | 0xC0B0 | Device 2 Status | Reserved | | | | SOF/EOP Timeout Interrupt Enable | Wake Interrupt Flag | SOF/EOP Interrupt Flag | Reset Interrupt Flag | xxxx xxxx | |
| | | | EP7 Interrupt Flag | EP6 Interrupt Flag | EP5 Interrupt Flag | EP4 Interrupt Flag | EP3 Interrupt Flag | EP2 Interrupt Flag | EP1 Interrupt Flag | EP0 Interrupt Flag | xxxx xxxx | |
| R/W | 0xC0C6 | HPI Mailbox | Message... | | | | | | | | 0000 0000 | |
| | | | ...Message | | | | | | | | 0000 0000 | |
| R/W | 0xC0C8 | SPI Configuration | 3Wire Enable | Phase Select | SCK Polarity Select | Scale Select | | | Reserved | 1000 0000 | | |
| | | | Master Active Enable | Master Enable | SS Enable | SS Delay Select | | | | 0001 1111 | | |
| R/W | 0xC0CA | SPI Control | SCK Strobe | FIFO Init | Byte Mode | FullDuplex | SS Manual | Read Enable | Transmit Ready | Receive Data Ready | 0000 0001 | |
| | | | Transmit Empty | Receive Full | Transmit Bit Length | | | Receive Bit Length | | | 1000 0000 | |
| R/W | 0xC0CC | SPI Interrupt Enable | Reserved... | | | | | | Receive Interrupt Enable | Transmit Interrupt Enable | Transfer Interrupt Enable | 0000 0000 |
| | | | ...Reserved | | | | | | Receive Interrupt Enable | Transmit Interrupt Enable | Transfer Interrupt Enable | 0000 0000 |
| R | 0xC0CE | SPI Status | Reserved... | | | | | Receive Interrupt Flag | Transmit Interrupt Flag | Transfer Interrupt Flag | 0000 0000 | |
| | | | FIFO Error Flag | Reserved | | | Receive Interrupt Flag | Transmit Interrupt Flag | Transfer Interrupt Flag | 0000 0000 | | |
| W | 0xC0D0 | SPI Interrupt Clear | Reserved... | | | | | | Transmit Interrupt Clear | Transmit Interrupt Clear | 0000 0000 | |
| | | | ...Reserved | | | | | | Transmit Interrupt Clear | Transmit Interrupt Clear | 0000 0000 | |
| R/W | 0xC0D2 | SPI CRC Control | CRC Mode | | CRC Enable | CRC Clear | Receive CRC | One in CRC | Zero in CRC | Reserved... | 0000 0000 | |
| | | | ...Reserved | | | | | | | | 0000 0000 | |
| R/W | 0xC0D4 | SPI CRC Value | CRC... | | | | | | | | 1111 1111 | |
| | | | ...CRC | | | | | | | | 1111 1111 | |
| R/W | 0xC0D6 | SPI Data Port t | Reserved | | | | | | | | xxxx xxxx | |
| | | | Data | | | | | | | | xxxx xxxx | |
| R/W | 0xC0D8 | SPI Transmit Address | Address... | | | | | | | | 0000 0000 | |
| | | | ...Address | | | | | | | | 0000 0000 | |
| R/W | 0xC0DA | SPI Transmit Count | Reserved | | | | | Count... | | | 0000 0000 | |
| | | | ...Count | | | | | | | | 0000 0000 | |

Table 15-1. Register Summary (continued)

| R/W | Address | Register | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Default High | | |
|-----|---------|---------------------|--------------|--------------|----------|---------------|------------|---------------|--------------|------------------|--------------|-------------|-----------|
| | | | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Default Low | | |
| R/W | 0xC0DC | SPI Receive Address | Address... | | | | | | | | | 0000 0000 | |
| | | | ...Address | | | | | | | | | 0000 0000 | |
| R/W | 0xC0DE | SPI Receive Count | Reserved | | | | | | Count... | | | 0000 0000 | |
| | | | ...Count | | | | | | | | | 0000 0000 | |
| R/W | 0xC0E0 | UART Control | Reserved... | | | | | | Scale Select | | Baud Select | UART Enable | 0000 0000 |
| | | | ...Reserved | | | | | | | | | | 0000 0111 |
| R | 0xC0E2 | UART Status | Reserved... | | | | | | | | | 0000 0000 | |
| | | | ...Reserved | | | | | | Receive Full | Transmit Full | | 0000 0000 | |
| R/W | 0xC0E4 | UART Data | Reserved | | | | | | | | | 0000 0000 | |
| | | | Data | | | | | | | | | 0000 0000 | |
| R | | HPI Status Port | VBUS Flag | ID Flag | Reserved | SOF/EOP2 Flag | Reserved | SOF/EOP1 Flag | Reset2 Flag | Mailbox In Flag | | | |
| | | | Resume2 Flag | Resume1 Flag | SIE2msg | SIE1msg | Done2 Flag | Done1 Flag | Reset1 Flag | Mailbox Out Flag | | | |

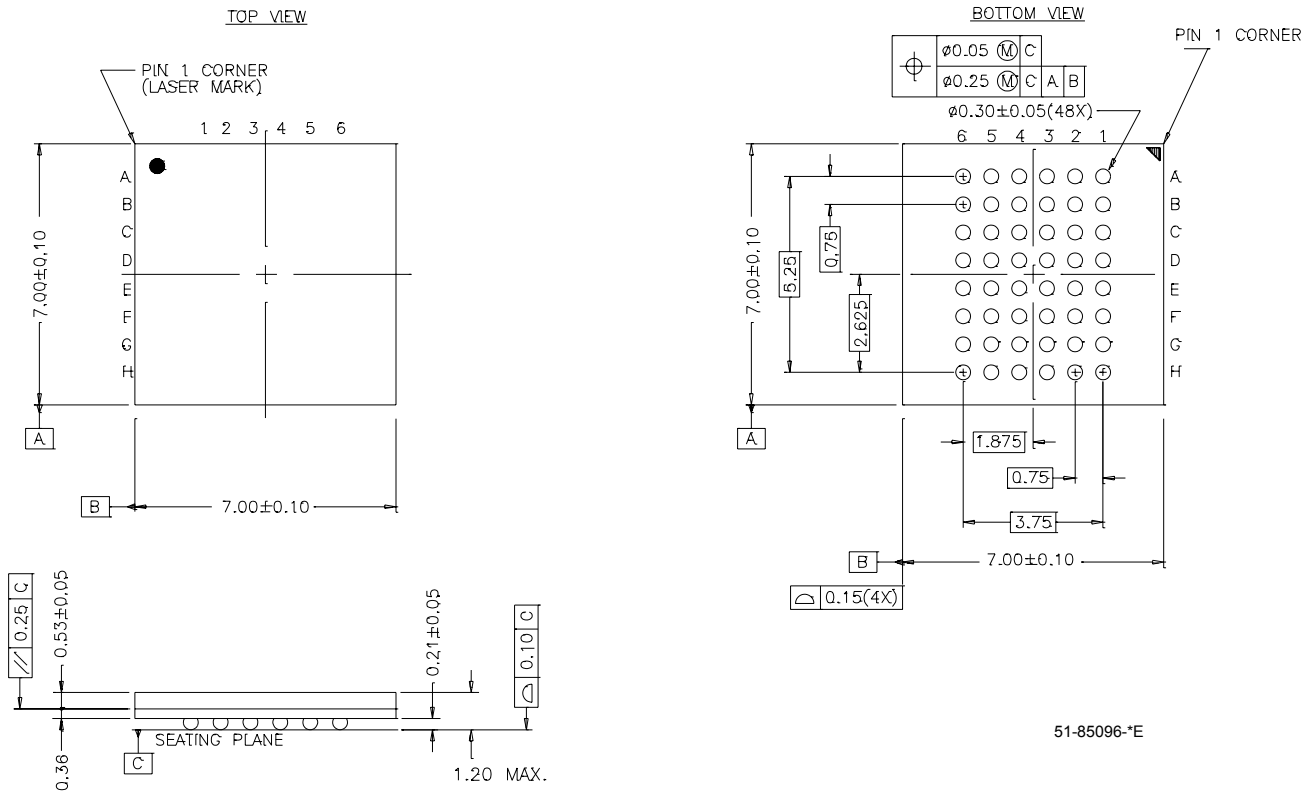
16.0 Ordering Information

Table 16-1. Ordering Information

| Ordering Code | Package Type | Temperature Range |
|-----------------|-----------------|-------------------|
| CY7C67200-48BAI | 48 FBGA | -40 to 85°C |
| CY3663 | Development Kit | |

17.0 Package Diagrams

48-Ball (7.00 mm x 7.00 mm x 1.2 mm) FBGA BA48A



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Document History Page

| Document Title: CY7C67200 EZ-OTG™ Programmable USB On-The-Go Host/Peripheral Controller | | | | |
|--|----------------|-------------------|------------------------|---|
| Document Number: 38-08014 | | | | |
| REV. | ECN NO. | Issue Date | Orig. of Change | Description of Change |
| ** | 111872 | 03/22/02 | MUL | New Data Sheet |
| *A | 116988 | 08/23/02 | MUL | Preliminary Data Sheet |
| *B | 124954 | 04/10/03 | MUL | Added Memory Map Section and Ordering Information Section Moved Functional Register Map Tables into Register section General Clean-up Changed from "Preliminary" to "Preliminary Confidential" |
| *C | 126211 | 05/23/03 | MUL | Added Interface Description Section and Power Savings and Reset Section Added Char Data General Clean-up Removed DRAM, MDMA, and EPP Added "Programmable" to the title page |
| *D | 127334 | 05/29/03 | KKV | Corrected font to enable correct symbol display |
| *E | 129394 | 10/07/03 | MUL | Final Data Sheet Changed Memory Map Section Added USB OTG Logo General Clean-up |



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