* 1. Memory Map of Development Board

|  |  |  |
| --- | --- | --- |
| 4.0 GB |  |  |
| 3.75 GB | RESERVED ADDRESS SPACE | 0xFFFF FFFF  0xF000 0000 |
| 3.5 GB | PERIPHERALS | 0xEFFF FFFF  0xE000 0000 |
|  | RESERVED ADDRESS SPACE | 0xDFFF FFFF  0x4000 8000 |
| 1.0 GB | 32 kB ON-CHIP STATIC RAM | 0x4000 7FFF  0x4000 0000 |
|  | RESERVED ADDRESS SPACE | 0x3FFF FFFF  0x0008 0000 |
|  | 512 kB ON-CHIP NON-VOLATILE MEMORY | 0x0007 FFFF  0x0000 0000 |
| 0.0 GB |  |  |

* 1. Detail View of Peripheral Memory Map

|  |  |  |
| --- | --- | --- |
| 3.75 GB |  |  |
|  | NOT USED | 0xEFFF FFFF  0xE020 0000 |
|  | System Control Block | 0xE01F C000 |
|  | NOT USED | 0xE01F 8000  0xE002 4000 |
|  | RTC | 0xE002 0000 |
|  | TIMER1 | 0xE001 C000 |
|  | TIMER0 | 0xE001 8000 |
|  | Interrupt Controller | 0xE001 4000 |
|  | BUTTON0-9 | 0xE001 0000 |
|  | LCD | 0xE000 C000 |
|  | LED0-7 | 0xE000 8000 |
|  | UART1 | 0xE000 4000 |
|  | UART0 | 0xE000 0000 |
| 3.5 GB |  |  |

* 1. Peripherals
     1. UARTs

The development board contains two 64-byte versions of the *standard* National Semiconductor UARTs. The model is 16750. For an in-depth explanation of the various registers and how to configure them, check out [this article](https://en.wikibooks.org/wiki/Serial_Programming/8250_UART_Programming).

* + 1. LED

The development board contains 8 programmable LEDs that can be turned on and off individually. The status of the LEDs can be queried by polling the respective bit of the LED Status Register. To enable LED n set the n-th bit of the LED Status Register. Likewise to disable LED n clear the n-th bit of the LED Status Register.

* + 1. LCD

The embedded LCD of the development board is modeled after the Hitachi HD44780, although a bit simplified. Check out the *Instruction Description* in the HD44780.pdf file and then look at the provided assembler and C example code. It should be pretty self explainatory then.

* + 1. Pushbuttons

The development board contains 10 Push Buttons. The status of the Push Buttons can be queried by polling the respective bit of the Button Status Register. If the button is pressed the bit will be set, otherwise it will be cleared. The least significant bit (LSB) corresponds to button 0.

* + 1. Timers

The development board has two timers used to generate interrupts as time-out timers or interval timers.

Each timer has a 16-bit counter. The cpu clock (CPUCLK, 1/16 CPUCLK and 1/256 CPUCLK) performs counting. Timer interrupts occur when the counter value reaches a certain value specified as the reference value, or when it overflows. The status register flag indicates which of the above has caused the interrupt.

* + 1. Programmable Interrupt Controller

The PIC is modeled after the PIC used in Samsung's S3C4510B microcontroller (also known as KS32C50100) and provides 21 lines for controlling up to 21 different interrupts.

For a detailed description of the exposed HW registers and how to configure the PIC, take a look at the S3C4510B Datasheet, Chapter 13 (Interrupt Controller).

**Overview of interrupt processing**

|  |  |  |
| --- | --- | --- |
| **Line** | **Name** | **Cause** |
| 4 | INT\_UART0TX | UART0 transmit-interrupt |
| 5 | INT\_UART0RX | UART0 receive-interrupt |
| 6 | INT\_UART1TX | UART1 transmit-interrupt |
| 7 | INT\_UART1RX | UART1 receive-interrupt |
| 8 | INT\_TIMER0 | TIMER0 overflow/compare interrupt |
| 9 | INT\_TIMER1 | TIMER1 overflow/compare interrupt |

* + 1. RTC
  1. Memory-Mapped Hardware Registers
     1. UART0

|  |  |  |
| --- | --- | --- |
| **U0RBR** | *UART0 Receiver Buffer* | 0xE000 0000 |
| **U0THR** | *UART0 Transmitter Holding Buffer* | 0xE000 0000 |
| **U0DLL** | *UART0 Devisor Latch Low Byte* | 0xE000 0000 |
| **U0DLH** | *UART0 Devisor Latch High Byte* | 0xE000 0004 |
| **U0IER** | *UART0 Interrupt Enable Register* | 0xE000 0004 |
| **U0IIR** | *UART0 Interrupt Identification Register* | 0xE000 0008 |
| **U0FCR** | *UART0 FIFO Control Register* | 0xE000 0008 |
| **U0LCR** | *UART0 Line Control Register* | 0xE000 000C |
| **U0LSR** | *UART0 Line Status Register* | 0xE000 0014 |
| **U0SCR** | *UART0 Scratch Register* | 0xE000 001C |

* + 1. UART1

|  |  |  |
| --- | --- | --- |
| **U1RBR** | *UART1 Receiver Buffer* | 0xE000 4000 |
| **U1THR** | *UART1 Transmitter Holding Buffer* | 0xE000 4000 |
| **U1DLL** | *UART1 Devisor Latch Low Byte* | 0xE000 4000 |
| **U1DLH** | *UART1 Devisor Latch High Byte* | 0xE000 4004 |
| **U1IER** | *UART1 Interrupt Enable Register* | 0xE000 4004 |
| **U1IIR** | *UART1 Interrupt Identification Register* | 0xE000 4008 |
| **U1FCR** | *UART1 FIFO Control Register* | 0xE000 4008 |
| **U1LCR** | *UART1 Line Control Register* | 0xE000 400C |
| **U1LSR** | *UART1 Line Status Register* | 0xE000 4014 |
| **U1SCR** | *UART1 Scratch Register* | 0xE000 401C |

* + 1. LED0-7

|  |  |  |
| --- | --- | --- |
| **LEDSTATUS** | *LED Status Register* | 0xE000 8000 |

* + 1. LCD

|  |  |  |
| --- | --- | --- |
| **LCDC\_IOCTL** | *LCD I/O Control Register* | 0xE000 C000 |
| **LCDC\_DATA** | *LCD Data Transfer Register* | 0xE000 C001 |

* + 1. BUTTON0-9

|  |  |  |
| --- | --- | --- |
| **BTNSTATUS** | *Button Status Register* | 0xE001 0000 |

* + 1. Programmable Interrupt Controller

|  |  |  |
| --- | --- | --- |
| **INTMOD** | *Interrupt Mode Register* | 0xE001 4000 |
| **INTPND** | *Interrupt Pending Register* | 0xE001 4004 |
| **INTMSK** | *Interrupt Mask Register* | 0xE001 4008 |
| **INTPRI0** | *Interrupt Priority Register 0* | 0xE001 400C |
| **INTPRI1** | *Interrupt Priority Register 1* | 0xE001 4010 |
| **INTPRI2** | *Interrupt Priority Register 2* | 0xE001 4014 |
| **INTPRI3** | *Interrupt Priority Register 3* | 0xE001 4018 |
| **INTPRI4** | *Interrupt Priority Register 4* | 0xE001 401C |
| **INTPRI5** | *Interrupt Priority Register 5* | 0xE001 4020 |
| **INTOFFSET** | *Interrupt Offset Register* | 0xE001 4024 |
| **INTOSET\_FIQ** | *FIQ Interrupt Offset Register* | 0xE001 4028 |
| **INTOSET\_IRQ** | *IRQ Interrupt Offset Register* | 0xE001 402C |
| **INTPNDPRI** | *Interrupt Pending By Priority Register* | 0xE001 4030 |
| **INTPNDTST** | *Interrupt Pending Test Register* | 0xE001 4034 |

* + 1. TIMER0

|  |  |  |
| --- | --- | --- |
| **T0\_MODE** | *Mode Setting and Status Register* | 0xE001 8000 |
| **T0\_COUNT** | *Counter Value Register (upper 16 bit fixed to 0)* | 0xE001 8004 |
| **T0\_COMP** | *Compare Value Register (upper 16 bit fixed to 0)* | 0xE001 8008 |

**T0\_MODE: Register for setting modes and reading status**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 3  1 | 0  7 | 0  6 | 0  5 | 0  4 | 0  3 | 0  2 | 0 0  1 0 |
| - | O  V  F  F | E  Q  U  F | O  V  F  E | C  M  P  E | C  U  E | Z  R  E  T | C  L  K  S |
|  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

|  |  |  |
| --- | --- | --- |
| **Name** | **Pos.** | **Contents** |
| CLKS | 1:0 | Clock Selection   1. CPUCLK (16.8 MHz) 2. 1/16 of the CPUCLK 3. 1/128 of the CPUCLK 4. 1/256 of the CPUCLK |
| ZRET | 2 | Zero Return   1. The counter keeps counting, ignoring the reference value 2. The counter is cleared to 0 when the counter value is equal to the reference value. |
| CUE | 3 | Count Up Enable   1. Stops counting. 2. Starts/restarts counting. |
| CMPE | 4 | Compare-Interrupt Enable   1. A compare-interrupt is not generated. 2. An interrupt is generated when the counter value is equal to the reference value. |
| OVFE | 5 | Overflow-Interrupt Enable   1. An overflow-interrupt is not generated. 2. An interrupt is generated when an overflow occurs. |
| EQUF | 6 | Equal Flag  The value is set to 1 when a compare-interrupt occurs.  Writing 1 clears the equal flag. |
| OVFF | 7 | Overflow Flag  The value is set to 1 when an overflow-interrupt occurs.  Writing 1 clears the overflow flag. |

**T0\_COUNT: Counter register**

|  |  |  |  |
| --- | --- | --- | --- |
| 3  1 | 1  6 | 1  5 | 0  0 |
| - | | COUNT | |
| 0 | | 0 | |

|  |  |  |
| --- | --- | --- |
| **Name** | **Pos.** | **Contents** |
| COUNT | 15:0 | Counter value  The counter value is incremented according to the conditions of the clock specified in the T0\_MODE register. |

**T0\_COMP: Comparison register**

|  |  |  |  |
| --- | --- | --- | --- |
| 3  1 | 1  6 | 1  5 | 0  0 |
| - | | COMP | |
| 0 | | 0 | |

|  |  |  |
| --- | --- | --- |
| **Name** | **Pos.** | **Contents** |
| COMP | 15:0 | Compare value  Reference value to be compared with T0\_COUNT. |

* + 1. TIMER1

|  |  |  |
| --- | --- | --- |
| **T1\_MODE** | *Mode Setting and Status Register* | 0xE001 C000 |
| **T1\_COUNT** | *Counter Value Register (upper 16 bit fixed to 0)* | 0xE001 C004 |
| **T1\_COMP** | *Compare Value Register (upper 16 bit fixed to 0)* | 0xE001 C008 |

**T1\_MODE: Register for setting modes and reading status**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 3  1 | 0  7 | 0  6 | 0  5 | 0  4 | 0  3 | 0  2 | 0 0  1 0 |
| - | O  V  F  F | E  Q  U  F | O  V  F  E | C  M  P  E | C  U  E | Z  R  E  T | C  L  K  S |
|  | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

|  |  |  |
| --- | --- | --- |
| **Name** | **Pos.** | **Contents** |
| CLKS | 1:0 | Clock Selection   1. CPUCLK (16.8 MHz) 2. 1/16 of the CPUCLK 3. 1/128 of the CPUCLK 4. 1/256 of the CPUCLK |
| ZRET | 2 | Zero Return   1. The counter keeps counting, ignoring the reference value 2. The counter is cleared to 0 when the counter value is equal to the reference value. |
| CUE | 3 | Count Up Enable   1. Stops counting. 2. Starts/restarts counting. |
| CMPE | 4 | Compare-Interrupt Enable   1. A compare-interrupt is not generated. 2. An interrupt is generated when the counter value is equal to the reference value. |
| OVFE | 5 | Overflow-Interrupt Enable   1. An overflow-interrupt is not generated. 2. An interrupt is generated when an overflow occurs. |
| EQUF | 6 | Equal Flag  The value is set to 1 when a compare-interrupt occurs.  Writing 1 clears the equal flag. |
| OVFF | 7 | Overflow Flag  The value is set to 1 when an overflow-interrupt occurs.  Writing 1 clears the overflow flag. |

**T1\_COUNT: Counter register**

|  |  |  |  |
| --- | --- | --- | --- |
| 3  1 | 1  6 | 1  5 | 0  0 |
| - | | COUNT | |
| 0 | | 0 | |

|  |  |  |
| --- | --- | --- |
| **Name** | **Pos.** | **Contents** |
| COUNT | 15:0 | Counter value  The counter value is incremented according to the conditions of the clock specified in the T1\_MODE register. |

**T1\_COMP: Comparison register**

|  |  |  |  |
| --- | --- | --- | --- |
| 3  1 | 1  6 | 1  5 | 0  0 |
| - | | COMP | |
| 0 | | 0 | |

|  |  |  |
| --- | --- | --- |
| **Name** | **Pos.** | **Contents** |
| COMP | 15:0 | Compare value  Reference value to be compared with T1\_COUNT. |

* + 1. System Control Block

The System Control Block includes several system features and control registers for a

number of functions that are not related to specific peripheral devices.

|  |  |  |
| --- | --- | --- |
| **PCON** | *Power Control Register* | 0xE01F C000 |

Setting the least significant bit (LSB) of the *Power Control Register* will power down the development board and return control to the calling JavaScript code.